DOWNLOADING DETERRENCE:
THE LOGIC AND LOGISTICS OF COERCIVE DEPLOYMENT ON U.S. STRATEGY

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APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

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ABSTRACT

This study proceeds in two parts. The first section is a theoretical and historical review of the role of logistics-enabled military presence as a part of coercive strategies. Operation NICKEL GRASS—the United States' logistical support to Israel during the Yom Kippur War—demonstrates how even permanently based forces may fail to deter aggression, while showing the successes and challenges of one of the first modern aerial logistics efforts. The deployment of United States forces as a part of Operations DESERT SHIELD and DESERT STORM was one of the largest military logistics operations of all time. Despite its coercive success, the ports of debarkation struggled to handle the tremendous flow of frontline forces, equipment, and sustainment. The time offered to the United States to deploy massive forces and overcome logistical hurdles may not be offered by future adversaries. Finally, the deployment of Task Force Hawk as a part of the conflict in Kosovo shows how even small force deployments face logistical hurdles as constraints at ports of debarkation slow the establishment of forward military presence. In sum, the theoretical review and historical cases suggest coercive strategies should employ forward presence, but that limits on throughput degrade the United States' current capacity to employ rapid mobility to its full potential.

The second section of the work examines the United States current aerial port technologies and concepts of operations. Part of this analysis rests on a recent Defense Advanced Research Projects Agency (DARPA)-commissioned project to model the United States logistics enterprise. The DARPA project infused potential technologies, like fast sealift and heavy vertical airlift, to examine investment strategies for research and development. While the United States military tends toward platform-centric research, this work demonstrates that investment in upload and download technologies is necessary to achieve real change in speed of throughput at the most constrained portion of the logistics enterprise: forward ports of debarkation. Taken as a whole, the work casts a vision of how the United States can continue to lead the world in force projection capabilities as a part of coercive strategies.

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THE BIG HOAX

In the waning days of 1963, news outlets across the western world were filled with triumph and tragedy—from recounts of Dr. King's inspiring "dream" to the confused conspiracies surrounding the assassination of President John F. Kennedy. Tucked among these high-profile events chirped the brief accounts of some 240 military-credentialed reporters and photographers detailing a watershed joint logistics exercise. These newsmen were invited by Secretary of Defense Robert S. McNamara to witness the BIG LIFT, the largest military troop movement to date. Over the course of sixty-three hours, 13,000 troops from the 2d Armored Division at Fort Hood, Texas, along with 1,500 support personnel from all across the country, were airlifted across the Atlantic to Berlin. Despite maintenance problems and poor weather in Europe, the lift deployed all of these troops nine hours ahead of schedule. Once on the ground, reporters and photographers—with unprecedented access—documented how the Texas-based troops married up with prepositioned equipment in Europe to perform maneuvers against the 3rd Armored Division already stationed in Germany. The BIG LIFT appeared to be an operational success.

For BIG LIFT's $20-million-dollar price tag, Secretary McNamara wanted to "provide a dramatic illustration of the U.S. capability for the rapid reinforcement of NATO."[1] More specifically, McNamara "wanted to demonstrate that US military forces in Europe could safely be reduced without impairing NATO's military strength. The money thus saved would not only reduce the US gold-flow but would go a long way toward

[1] Quoted in Michael Pakenham, "U.S. to Fly Division to Europe," *Chicago Tribune* (24 September 1963): Section 1 page 3.

achieving Mr. McNamara's $4 billion cost-reduction goal in defense expenditures."[2]

The apparent success of BIG LIFT, however, belied the timelines suggested to the press. The speed of a sixty-three hour deployment rested on the work of thousands of additional man-days totaling several months. Seventh Army in Germany *added* 91,000 man-days to ready the tanks, personnel carriers, jeeps, trucks, and field kitchens the deploying 2d Armored Division used in the impending maneuvers.[3] Additionally, 2nd Armored Division, starting in late September, added thousands of troops to its units, initiated intense predeployment training, and sent senior leaders to Germany to prepare for the impending maneuvers. Given this herculean preparation, BIG LIFT was not a useful demonstration of the preposition-equipment concept, "for in its selling job DoD had taken no chances...."[4] When the 2nd Armored Division arrived, vehicles were lined up on an unused stretch of autobahn, gassed up and ready to roll. This additional effort was designed to give the press—and its international readers—the perception of a smooth deployment machine. The true story of BIG LIFT is a well-rehearsed, months-long, manpower-intensive exercise under the most permissive conditions available. Despite Secretary McNamara heralding the success of BIG LIFT, most military personnel thought the intense preparations prior to the movement of the 2nd Armored merely proved that BIG LIFT was a "Big Hoax."[5]

Hoax or not, BIG LIFT offers several compelling suggestions to practitioners of military logistics and students of deterrence theory. First, though BIG LIFT could not have been executed into hostile

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[2] Allan R. Scolin, "Big Lift: Boom, Boondoggle, or Bust," *Air Force Magazine* 46, no. 12 (December 1963): 33.
[3] Scolin, "Big Lift," 36.
[4] Scolin, "Big Lift," 36.
[5] David I. Goldman, "Operation BIG LIFT," Official website of the United States Army, 14 October 2009, http://www.army.mil/article/28749/Operation_BIG_LIFT/

territory—due to the threat to prepositioned equipment and access to airfields—the exercise did provide the first demonstration of large-scale reinforcement capability in a potentially tense environment.[6] Second, rapid deployment of large-scale forces is a matter of months, not days. The 2d Armored carried a mere 3.4 million pounds of baggage and light weapons. To transport the full equipment of an armored division in 1963 would have required an airlift capacity of thirty-two million pounds.[7] That number has only grown as divisions increase in size, weight, and complexity. Given lift requirements of this magnitude, the United States relies on prepositioned equipment—equipment that requires months of intense manpower dedicated to bringing that kit to operational capacity. Consequently, the speed with which large American forces are brought to a contingency has remained relatively static for the past fifty years. Finally, BIG LIFT's rapid deployment to Germany provided the real-world evidence to reduce United States' forces overseas while reassuring allies of American security guarantees. This reduction did not eliminate America's "trip-wire" forces in West Berlin, but, rather, demonstrated that strategic mobility could potentially enforce American presence globally—wherever American interests were challenged.

The aspirations on which BIG LIFT rested remain a foundational piece of the Untied States security policy—Strategic Mobility. Prepositioned equipment, coupled with strategic airlift, remain fundamental assumptions in American warplans, ostensibly allowing the United States to react with unparalleled speed to contingencies around the globe.

Interestingly, the United States currently faces a political and fiscal situation similar to the dilemmas faced by Secretary McNamara in the 1960s. Constricting economies and reduced fiscal spending put the

[6] Scolin, "Big Lift," 37.
[7] Scolin, "Big Lift," 37.

United States' current fixed-base assets at risk, while the post-Cold War international order requires increasing American presence abroad. A resurgent Russian threat in Eastern Europe, Chinese adventurism in the Pacific, civil war in Syria and Iraq, and global terrorism all stress the personnel, readiness, and international presence of the smallest American military since the end of World War II.

Consequently, the Department of Defense recently embarked on an effort to find the "third offset." The first offset bolstered the perceived inferior numbers of U.S. troops by the threat of overwhelming American nuclear reprisal. The second offset pitted precision-guided weapons over the numerical superiority of America's enemies. Conventional thinking suggests a third offset will again harness new technologies, such as drones, hypersonics, space, and cyber weapons to combat insurgents and near-peers alike.

While any advances in these technologies inevitably increase the United States' tactical edge over the spectrum of potential adversaries, rapid deployment and redeployment of forces remain critical to America's defense posture. Unfortunately, since the advent of airlift, military logistics has enjoyed only sporadic investment and incremental technological advances. Even when investment in logistics occurs, organizational inertia tends to focus on the acquisition of platforms: faster aircraft and ships with increased lift capacity.

Though recapitalization and modernization of aging lift platforms is fundamental to America's global reach, a recent DARPA study confirmed that the most constraining factor on deployment time was working Maximum on Ground (MOG): the maximum number of aircraft that can be simultaneously "worked" by maintenance, aerial port, and others.[8] This analysis—and the studies it confirms—suggests investment in

[8] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors,* 12 December 2011, table 3, page 26.

revolutionary expeditionary onload/offload technologies is required to eliminate the most limiting constraint on America's global mobility. Developing new technologies that speed these operations, reduce their footprint, and eliminate the need for specialized equipment could dramatically change the way America employs its military instrument of power. By increasing throughput, and speeding deployment of sizable combat forces, America can respond to the cacophony of international crises while simultaneously holding in reserve the capacity to deploy deterrent forces into theaters of near-peer adventurism.

Is Strategic Mobility critical to the United States' defense posture? If so, what impact does the speed of rapidly deployable presence have on America's coercive capacity? What key investments are needed? To answer these questions, this paper reviews deterrence theory to highlight the role of rapidly deployable presence as an influence on interstate interaction and conflict. This theoretical review leads to analyses of both fixed and mobile presence, investigating the pivotal role of presence in comprehensive coercive strategies. The current aerial port logistics equipment, concepts of operation, and expeditionary logistics forces are reviewed to determine America's current capacity to rapidly deploy military forces. Then, the DARPA study is briefly dissected, illustrating not just the current state of the art but also the impact of robust prepositioning, advanced lift platforms, and the potential of revolutionary new technologies. Finally, the paper concludes with a vignette highlighting advanced upload and download technology in action, providing a vision for the United States' future capacity to rapidly deploy coercive military presence.

CHAPTER 2

THEORY AND COERCIVE PRESENCE

This chapter explores the theoretical underpinnings of deterrence as one of the two forms of coercion. In so doing, forward presence is examined as a mechanism of deterrence. A brief review of post-Cold War trends in forward basing is presented, highlighting America's decrease in permanent fixed bases. Collectively, the theoretical examination and basing trends point toward two distinct recourses to establish forward presence: a reversal of current trends in basing, or the development of advanced deployment capabilities to forward bases in areas of strategic concern.

Defining Coercion

"The power to hurt is bargaining power. To exploit it is diplomacy—vicious diplomacy, but diplomacy," pronounced Thomas Shelling in his seminal work, *Arms and Influence*.[1] Shelling equates "the power to hurt" to coercive force—the martial component of diplomatic bargaining. Further refined, coercion is "the use of threatened force, including the limited use of actual force to back up the threat, to induce an adversary to behave differently than it otherwise would."[2] To be coerced successfully, an adversary must comply with diplomatic demands while it still has the means to resist.[3] Successful coercive force compels or deters. As Byman, Waxman, and Larson explain:

> Compellence involves attempts to reverse an action that has already occurred or to otherwise overturn the status quo, such as evicting an aggressor from territory it has just conquered.... Deterrence, on the other hand, involves preventing an action that has not yet materialized from occurring in the first place.

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[1] Thomas C. Schelling, *Arms and Influence*, (New Haven, CT: Yale University Press, 2008), 2.
[2] Daniel L. Byman, Matthew C. Waxman, and Eric Larson, *Air Power as a Coercive Instrument*, (Washington, D.C., RAND, 1999), 10.
[3] Byman, Waxman, and Larson, *Air Power as a Coercive Instrument*, 13.

> Deterrence would include dissuading an aggressor from trying to conquer a neighboring state ....[4]

Despite the theoretical distinction, determining compellent from deterrent actions is often difficult. Both coercive forms "ultimately boil down to inducing the adversary to choose a policy other than that planned."[5] Though both the compelling and the deterring "power to hurt" imbue the military instrument with coercive character, this analysis focuses on the deterrent capacities of that instrument.

Conventional deterrence takes two distinct forms: deterrence by presence or deterrence by punishment.[6] Permanently stationing or deploying conventional forces to a location that increases the uncertainty and potential costs to an aggressor deters by presence.[7] The size and destructive capability of these conventional forces correlate to their deterrent effect. In some cases deployed forces may not be able to mount a credible defense; in others, they may escalate the potential costs of an aggressor up to and including that adversary's defeat.[8] As implied by the definition of deterrence by presence, the location of those forces matter. Conventional forces may be more or less deterrent due to their location and capacity to deploy. So, whether forces are permanently stationed abroad or are stationed at home and are rapidly deployable determines their deterrent effect. Analysis of permanent versus mobile forward presence is presented later in this chapter.

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[4] Byman, Waxman, and Larson, *Air Power as a Coercive Instrument*, 10.
[5] Byman, Waxman, and Larson, *Air Power as a Coercive Instrument*, 11.
[6] I excluded a third type of deterrence—defense—intentionally, as it is really just presence of an increased size and capability. Not all deterrence theorists agree.
[7] I intentionally confine deterrence by presence to conventional forces. While Soviet nuclear presence in Cuba and American nuclear presence in Turkey had clear effects on the international security environment, and while nuclear-armed submarines are still a part of today's deterrent strategies, deterrence by presence is dominated by conventional forces now that nuclear weapons are predominantly based domestically.
[8] Samuel P. Huntington, "Conventional Deterrence and Conventional Retaliation in Europe," *International Security 8, no. 3 (Winter, 1983-1984):* 36.

On the other hand, deterrence by punishment threatens the destruction of highly valued assets of a potential aggressor, putting these targets at perpetual risk. [9] "Unlike deterrence by presence… this form of deterrence … requires …the aggressor … to calculate not only the defender's capabilities to implement a retaliatory threat but also the credibility of that threat."[10] Conventional deterrence by punishment has existed since the birth of warfare. Deterring actors threatened to use conventional armies to strike adversaries should that adversary put the vital interests—whatever they may be—of the deterring state in jeopardy. However, since the advent of the nuclear age, deterrence by punishment "has been the classic role of strategic nuclear forces."[11] Nuclear weapons are different not because of the number of people they can kill, but because they can kill so many so quickly. In essence, nuclear weapons put the primary, vital interest of states—survival—in constant jeopardy.

Deterrence by punishment—specifically nuclear deterrence—dominated the study of coercion during the Cold War. As Schelling explains, "Man has, it is said, for the first time in history enough power to eliminate his species from the earth, weapons against which there is no conceivable defense."[12] With the emergence of nuclear parity, second-strike capabilities, and the horizontal and vertical proliferation of nuclear weapons, all nations labor under the threat of extinction, should a nuclear-armed adversary initiate a nuclear conflict. Parity and proliferation soon presented actual and intellectual bounds to the nuclear deterrence as the dominant form of deterrence by punishment.

The Limits of Nuclear Deterrence

Though the mantle of nuclear deterrence blankets the international security environment, this deterrence inhibits, but does not

[9] Huntington, "Conventional Deterrence and Conventional Retaliation in Europe," 36.
[10] Huntington, "Conventional Deterrence and Conventional Retaliation in Europe," 36.
[11] Huntington, "Conventional Deterrence and Conventional Retaliation in Europe," 36.
[12] Shelling, *Arms and Influence,* 18.

prevent, all conventional force application. During the Cold War, the United States and the Soviet Union "…seemed to view a clash of conventional forces against each other (or core allies) as a very dangerous precursor to a nuclear exchange that could readily escalate into a catastrophic general war of unprecedented destructiveness."[13] For rational actors, the emergence of this norm is hardly surprising. If the cost of using force against a nuclear adversary risks state survival, other avenues of power-projection offer far more efficient means of pursuing national interests.

However, states routinely employ limited conventional force despite the influence of nuclear weapons. Both North Korea and North Vietnam continued conventional offensives against their southern counterparts despite the involvement of a nuclear-armed United States. Additionally, nuclear weapons failed to "dissuade Egypt from attacking Israel in the 1973 Yom Kippur War or Argentina from attacking the British-controlled Falkland Islands in 1982."[14] The deterrent effect of nuclear weapons against non-nuclear states appears questionable.

The deterrent notion of conventional wars spiraling into total nuclear war also appears conditional as the Kargil War between Pakistan and India illustrates. Both nations checked their respective nuclear weapons employment even when in direct conventional conflict concerning the disputed regions of Jammu and Kashmir. "On a strategic level, the Kargil War vividly demonstrated that a stable bilateral nuclear deterrence relationship can markedly inhibit such regional conflicts in intensity and scale—if not preclude them altogether."[15] To be clear,

[13] David Deudney, "Hegemony, nuclear weapons, and liberal hegemony," in *Power, Order, and Change in World Politics*, ed. G. John Ikenberrry, (Cambridge, U.K.: Cambridge University Press, 2014), 207.
[14] Michael S. Gerson, "Conventional Deterrence in the Second Nuclear Age," *Parameters* 39, no. 3 (Autumn 2009): 35.
[15] Benjamin S. Lambeth, *Airpower at 18,000', (*Washington, D.C.: Carnegie Endowment for International Peace, 2012), 2.

India's nuclear deterrent failed to halt Pakistani aggression; however, these weapons appeared to deter both states from escalating a limited conflict into total war.

Despite nuclear weapon proliferation and continual conventional conflicts, no nation has employed nuclear weapons since 1945, even when nuclear states engaged in direct hostilities. Furthermore, while implicit or explicit nuclear threats may lack credibility against non-WMD regimes, the terrible threat of nuclear total war continues to shape the international security environment in the post-Cold War era.[16] Nonetheless, nuclear deterrence has limits. Given these limits of deterrence by punishment, leaders and strategists have turned to the flexibility of conventional forces to provide coercive effect.

Conventional Deterrence and its Limits

Though the modern study of deterrence finds its roots in the dawn of the nuclear era, deterrence through conventional means is traceable to the earliest recorded military histories. Armies and navies checked aggression between Greek city-states in much the same way states' standing militaries threaten violence against other nations today. Therefore, conventional forces, like nuclear weapons, provide deterrent value through their ability to deny adversaries their objectives via military means. However, the ability to provide deterrence by presence instills conventional forces with unique attributes for coercive strategies.

Advances in the number, destructive capacity, and precision of conventional weapons provided deterrent options similar to the intellectual underpinnings of nuclear deterrence. As Soviet nuclear parity and survivability emerged, the Eisenhower Administration's policy of "Massive Retaliation" was called into question.[17] "As a result, western military strategy shifted from total reliance on nuclear weapons as a

[16] Gerson, "Conventional Deterrence in the Second Nuclear Age," 35.
[17] Gerson, "Conventional Deterrence in the Second Nuclear Age," 34.

means of deterring both Soviet conventional and nuclear aggression to a strategy of 'Flexible Response,' which included conventional and nuclear elements."[18] Technologically advanced conventional weapons now had the capacity to deter through a wider range of conflict intensity, even usurping nuclear weapons as a formidable deterrent up to nuclear thresholds. This convergence of thought regarding the utility of conventional forces recognized the trajectory that investment in technological advancement would have on kinetic conventional weapons.

The United States sought to advance qualitatively its conventional forces to offset the quantitative advantage of the Soviet Union.[19] These advances first proved their worth in the Arab-Israeli wars. Initially, Egyptian and Syrian surface-to-air missiles (SAMs) proved deadly to the Israeli Air Force; however, advances in precision guided munitions (PGMs) altered the balance of conventional forces. The success of Israeli Air Force strikes against SAMs as the wars progressed reinvigorated confidence of "fighters, planners, and commanders in their ability to gain air superiority over the most sophisticated Soviet air defense systems."[20]

If the Arab-Israeli wars bore the first fruit of technological investment in conventional systems, the first Persian Gulf War reaped the first large-scale harvest. After Operation Desert Storm "many defense analysts concluded that 'smart' weapons could provide a powerful deterrent against a wide variety of threats."[21] Destructive yields continued to improve just as the Global Positioning System constellation provided unparalleled targeting capabilities to the growing arsenal of PGMs. Instead of requiring multiple conventional platforms to ensure the destruction of a single target, advanced weapons systems could

[18] Gerson, "Conventional Deterrence in the Second Nuclear Age," 34.
[19] Keith L Shimko, *The Iraq Wars and America's Military Revolution*, (Cambridge, U.K.: Cambridge University Press, 2010), 36.
[20] John Andreas Olsen, *A History of Air Warfare*, (Washington, D.C.: Potomac Books, Inc., 2010), 151.
[21] Gerson, "Conventional Deterrence in the Second Nuclear Age," 35.

engage multiple targets from a single platform. Conventional air forces, in particular, benefited from this revolution in military technology. "The overall percentage can be expected to grow in future contingencies as precision-guided munitions (PGMs) become ever more plentiful and, as a result, as even small groups of combatants, such as a handful of enemy troops manning a mortar position, may eventually be deemed worth of a PGM in some circumstances."[22]

Conventional forces do not just deter by punishment, they also deter by sheer presence, specifically via the concept of tripwires. The notion of tripwires, implies that those forces are positioned in such a way, that if they are attacked, the deterring nation must respond in kind, usually by significantly escalating the developing conflict. Shelling's description of the tripwire forces in Berlin is illustrative.

> [W]hile 'trip wire' is a belittling word to describe an army, the role is not a demeaning one. The garrison in Berlin is as fine a collection of soldiers as has ever been assembled, but excruciatingly small. What can 7,000 American troops do, or 12,000 Allied troops? Bluntly, they can die. They can die heroically, dramatically, and in a manner that guarantees that the action cannot stop there. …Precisely because there is no graceful way out if we wished our troops to yield ground, and because West Berlin is too small an area in which to ignore small encroachments, West Berlin and its military forces constitute one of the most impregnable military outposts of modern times. The Soviets have not dared to cross *that* frontier.[23]

Shelling's description implies that conventional tripwires will prevent an adversary from attacking merely through the threat of prohibitive punishment. "Tripwires do not require the capacity to win a local military engagement to make the threat of escalation credible.[24] As Shelling states, "[b]eing able to lose a local war in a dangerous and

[22] Olsen, *A History of Air Warfare*, 271.
[23] Shelling, *Arms and Influence,* 47.
[24] Shelling, *Arms and Influence,* 104.

provocative manner may make the risk…outweigh the apparent gains to the other side."[25] A deterring state need only position a tripwire and then wait. The overt act is left to the opponent.[26] In this way, tripwire forces complicate an adversary's cost-benefit calculus.

Conclusion

The past seven decades saw a growth in research and theory of coercion, specifically deterrence. While nuclear weapons and their deterrent value lay at the heart of this renaissance, western strategists eventually turned to conventional means to provide a spectrum of military-escalation options. The potential for limited conflict to blossom into total war under the shadow of nuclear deterrence was a perennial concern throughout the Cold War, and that scenario remains relevant.[27] But, the quest for strategic options led to a resurgence in conventional deterrence theory. This theory led to technological investment that narrowed the gap between the effects of nuclear and conventional weapons. Moreover, the rise in conventional-force effects magnified the most unique quality of those forces—presence. As the theoretical potential of conventional forces increased, their role in deterrence by presence was amplified at the same time. Tripwire forces continue to provide the visible demonstration of deterrence in grand coercive strategies, even as nuclear weapons continue to underwrite the less discussed deterrent form.

What is the historical evidence for successful employment of forward presence and tripwire forces? Does the size or capabilities of forward forces matter? Must tripwires be permanently stationed abroad, or can they be rapidly deployed to locations of contested interest? The next chapter begins to answer these questions through historical case studies.

[25] Shelling, *Arms and Influence,* 104-105.
[26] Shelling, *Arms and Influence,* 71.
[27] Gerson, "Conventional Deterrence in the Second Nuclear Age," 36.

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CHAPTER 3

HISTORICAL EVIDENCE FOR FIXED AND MOBILE PRESENCE

The history of conventional coercion is checkered. Since the emergence of standing armies, states with these permanent forces continue to fall prey to attack. Similarly, the constant threat of attack is not always sufficient to coerce adversaries to achieve desired ends. In other words, standing armies sometimes must take up arms to coerce. Despite the checkered history of conventional coercion, air-delivered deployment and sustainment of military forces is a phenomenon born of the 20th century. This chapter analyzes three air-logistics operations that highlight different aspects of military presence while simultaneously demonstrating the routine difficulties of air logistics. Beginning with a failure of conventional deterrence, the chapter opens with an analysis of Operation NICKEL GRASS—the United States' response to the Yom Kippur War. On the verge of defeat from multiple Arab aggressors, Israel called on the United States to provide an air bridge to rearm the struggling Israeli armed forces. Despite diplomatic over-flight prohibitions, restricted airfield access, and inadequate material-handling equipment (MHE), NICKEL GRASS demonstrates the ability to deter continued aggression through overwhelming logistics capacity. The chapter turns to the deployment of forces to Saudi Arabia in support of Operations DESERT SHIELD and DESRT STORM. This case illustrates the culmination of the Cold War model of extended deterrence via mobile presence. The successful response to the Iraqi invasion of Kuwait demonstrates the herculean complexity required to provide deterrent presence, even in semi-permissive environments and given unrestricted timelines. The strike force that eventually liberated Kuwait took months to marshal; but the initial deterrent presence arrived relatively quickly. The case reviews debates surrounding the ground campaign that

followed initial airstrikes, highlighting the success of presence as a part of a cumulative coercive effort. In sum, the Operation DESERT SHIELD/STORM case demonstrates the temporal and material limits of rapid insertion of forward presence. Finally, the chapter reviews the deployment of Task Force Hawk in support of humanitarian operations in Kosovo. Though the Task Force never saw combat, the presence of these forces played a crucial role in targeting Serbian forces in Kosovo and affecting Slobodan Milosevic's decision to accede to United Nations' demands.

All three cases highlight the role of presence supported by air logistics; however, the three vary greatly in many important respects. The NICKEL GRASS case demonstrates the risks and vulnerabilities of deployed permanently, forward forces, but shows how vast amounts of manpower and total mobilization can overcome aerial-port challenges. The deployment of forces for Operation DESERT SHIELD and DESERT STORM shows how potential capacity at ports of debarkation close to the fight can compensate for the absence of permanently forward presence. The Task Force Hawk case illustrates the challenge of building expeditionary aerial port capacity for even relatively small deployments, but shows the role military presence plays in conflict resolution short of invasion. While the skirmishes, battles, and maneuvers of the campaigns are riveting, the foregoing analysis focuses on the war of logistics—the quiet, but conflicted, effort to download deterrence.

The Airlift that Saved Israel

From first declaring its independence on 14 May 1948, Israel has perpetually fought for its very existence. Between 1948 and 1973, Israel's armed forces formally engaged its Arab enemies on three distinct occasions; and, in every instance won. Largely based on its spectacular and overwhelming victory in the Six-Day War of 1967, Israel's leadership came to seriously underestimate its enemies and the Soviet military

capabilities they had procured.[1] On 6 October 1973, the Israeli's miscalculations nearly led to defeat. On that day, "Syria and Egypt, in a concerted effort to retrieve ground lost to the Israelis during the 1967 Six-Day War, simultaneously struck the Jewish state on two fronts: the Golan Heights in the northeast and the Sinai Peninsula to the West."[2] Israeli forces reeled under the weight of the combined Egyptian and Syrian attack. "Before long, 11 other Middle Eastern powers, most notably those at the spigots of precious oil flows to the West, lined the edges of the fray and brandished promises to cut petroleum supplies to the United States unless the Israelis met Arab demands."[3]

The conflict pitted proxies of both the United States and the Soviet Union against one another. Arab nations, armed with state-of-the-art Soviet technology, tested their new kit against the American arsenal of the Israelis. The fierce fighting rapidly depleted the ammunition stores of both sides of the conflict. In particular, "[t]he Israelis required vast numbers of high-explosive antitank shells, sabot-discarding antitank rounds, and, above all, anti-tank missiles. In the air, they needed replacement aircraft, parts, armament and electronic equipment to detect and defeat the new Soviet antiaircraft batteries."[4] In much the same way, the Arab nations appealed to their Soviet benefactors for resupply. Recognizing their allies required speed as well as mass, both the United States and Soviet Union turned to airlift to restock the dwindling stores of their respective proxies.

On 13 October President Nixon made the decision to begin the airlift, dubbed Operation NICKEL GRASS. The Operation faced

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[1] Boyne, *The Two O'Clock War,* page ix.
[2] John C. Brownlee, "An Air Bridge to Tel Aviv: The Role of the Air Force Logistics Command in the 1973 Yom Kippur War," *Air Force Journal of Logistics* 15, no. 1 (Winter 1991), 35.
[3] Brownlee, "An Air Bridge to Tel Aviv," 35.
[4] Edward T. Russell, "Military Airlift to Israel: Operation NICKEL GRASS," in *Short of War: Major USAF Contingency Operations*, ed. A. Timothy Warnock, (Montgomery, AL: Air University Press, 2000), 76.

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significant constraints from the outset. The threat of oil embargo drove America's European allies and many American commercial airlift operators from supporting the mission, leaving the bulk of the lift to the Israeli El Al airlifters and the United States Military Airlift Command (MAC). Unfortunately, the stripped down 707 and 747 El Al jetliners had insufficient payload capacity to support the requirements of the Israeli war machine. The Israeli defense effort consumed $952 million worth of planes, armor, and munitions in the first 100 hours of the conflict.[5] "While Israel surely needed rifles, bombs, and other combat paraphernalia, it most needed jet fighter-bombers, aircraft missiles, tanks, and anti-tank rockets."[6] The over- and outsized-cargo requirements demanded military assets for airlift. The MAC airlifters could carry almost any piece of equipment that the Israeli armed forces needed. "The C-141 could accommodate ammunition, supplies, aircraft parts, and many vehicles, while the C-5 could carry tanks, aircraft fuselages, helicopters, and large guns."[7]

At that time, the C-141s were without air refueling capability and the crews of the new C-5s had not trained for air-refueling missions. Consequently, these platforms required a base in the European theater to refuel prior to continuing their missions to Israel. American bases in Britain, Germany, and Spain could not be used as those nations depended on Middle Eastern oil. Therefore, they refused to support the United States' airlift operation. Luckily, Portugal feared little from an Arab oil embargo. Significant oil reserves in Portugese-controlled Angola offered Portugal room for political maneuver. In exchange for use of Lajes field in the Atlantic, Portugal petitioned the United States for arms and relaxed export controls. Lajes was ill-equipped to handle the traffic of the operation, eventually requiring an additional 1,300 personnel to

[5] Brownlee, "An Air Bridge to Tel Aviv," 36.
[6] Brownlee, "An Air Bridge to Tel Aviv," 36.
[7] Russell, "Military Airlift to Israel," 78.

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support the inbound and outbound aircraft.[8] Sleeping on aircraft, in World War II barracks, psychiatric wards, and showers, the augmenting personnel made due to ensure the success of the air bridge.[9] Had Portugal not offered Lajes as an intermediate stop en route to Israel, American airlift could not have ranged the 6,000 miles necessary to support America's besieged Israeli ally.

With a viable en route staging base, MAC set the combat-tested C-141s and new C-5s to work. Following a serpentine route to avoid the European landmass and stay outside the Flight Information Region (FIR) of the Arab states on the North African Caost, the first U.S. military transport, a C-5, landed at Lod International Airport Tel Aviv on 14 October.[10] Conditions at Lod proved even more difficult than Lajes, not because of overcrowding, but due to a lack of U.S. personnel.[11] To augment Lod, MAC sent Col Donald R. Storbaugh and an Airlift Control Element (ALCE) to establish a minimum presence to begin downloading American inbound aircraft. Beginning with only 12 cargo handlers and 20 communications workers, the ALCE at Lod never exceeded 55 people during the 32 days of the airlift.[12]

Due to engine trouble, the aircraft carrying Colonel Strobraugh, the ALCE, and the requisite material-handling equipment (MHE) diverted back to Lajes. The first supplies necessary to rearm an Israeli army that might turn the tide against the Syrians arrived 14 October. As Walter Boyne describes in *The Two O'Clock* War, "The appearance of a U.S. cargo plane in the combat zone gave the world notice of American resolve

[8] Walter J. Boyne, "Nickel Grass," *AIR FORCE Magazine* 81, no. 12 (December 1998), 58.
[9] Captain Chris J. Krisinger, "OPERATION NICKEL GRASS," *Airpower Journal* 3, no. 1 (Spring 1989), 24.
[10] Major Thomas J. Riney, "Transforming Past Lessons to Mold the Future: A Case Study on Operation NICKEL GRASS." Master's thesis, Air Force Institute of Technology, June 2003, 3.
[11] Krisinger, "OPERATION NICKEL GRASS," 24.
[12] Krisinger, "OPERATION NICKEL GRASS," 24.

and commitment. To Israel it meant that all concerns about diminishing ammunition and other supplies were over."[13] Jubilant at the physical manifestation of American support, the Israelis set about downloading the first C-5 by hand. The Israeli Defense Force employed 150 personnel—a mixture of reserve troops and civilian teenagers enlisted as laborers from the surrounding area—to download all 97 tons of 105mm howitzer shells in three and one-half hours.[14] "Even as the Israeli workers unloaded those first cargo airplanes, huge formations of Israeli and Egyptian armor, maneuvering just 100 miles to the southwest, were locked in a desperate tank battle that would prove to be the largest clash of armor since the World War II Battle of Kursk." [15] Getting the ammunition off the aircraft quickly was the first step in a time-sensitive process to ensure the reeling Israeli forces had enough firepower to slow the Arab advance.

The backbreaking work found some relief once Colonel Strobaugh, the 55-man ALCE, and its three 40K loaders arrived. The K-loaders were designed specifically to unload the C-5 aircraft, significantly speeding download of arriving aircraft.[16] Colonel Strobaugh then set about dividing up the Israeli aerial port augmentation reserves into teams of five to ten personnel. The aerial port augmentees thrived on the competition of setting records for fastest download. Their fervor, and the swarms of airlifters arriving at Lod, drove the next bottleneck in the aerial port operation. "Once the K-loaders were full of pallets, they were driven to a breakdown area to be unloaded. This pallet breakdown area quickly became a bottleneck."[17] Colonel Strobaugh suggested that trucks be built by fitting semi-trailers with rollers similar to rollers on the floor

[13] Boyne, "The Two O'Clock War," page 140.
[14] Krisinger, "OPERATION NICKEL GRASS," 24.
[15] Boyne, "Nickel Grass," 58.
[16] Boyne, "Nickel Grass," 58.
[17] Riney, "Transforming Past Lessons to Mold the Future," 16.

of the C-141 and C-5 aircraft.[18] K-loaders full of pallets of ammunition and supplies slid their loads onto newly fashioned trucks for onward movement from the airfield. The Israelis quickly built eight of these roller trucks which, when coupled with the vast reserves supporting download and dispersal operations, saved hundreds of hours in offload time.[19] By the end of the airlift, cargo downloaded from the aircraft usually arrived at the front in Syria in about three hours and in the Sinai in less than 10 hours.[20]

After the first day, the USAF set the daily flow requirement at four C-5s and twelve C-141s. Within three days, Military Airlift Command delivered, on a daily basis, nearly 1,000 tons of critically needed ammunition, medical supplies, missiles, aircraft parts, helicopters, F-4 fuselages, 175-millimeter cannons, 155-millimeter howitzers, and even M-60 and M-48 tanks.[21] As the Israelis stabilized the front in the Golan Heights, they turned their attention to the Sinai. Preparing for an impending assault across the Suez, the airlift requirement increased from four C-5s and twelve C-141s daily to six C-5s and seventeen C-141s.[22] Ultimately, Israel's ground forces recovered all territory lost to Syria and marched on Damascus, while simultaneously retaking the Sinai, crossing the Suez, and encircling the Egyptian Third Army. Fearing any further devastation of their Arab proxies, the Soviet Union lobbied heavily for a ceasefire.

On 28 October, the Yom Kippur War ended with a tenuous cease-fire. All told, Israel suffered 10,800 killed and wounded—a traumatic loss for a nation of some 3 million persons—plus 100 aircraft and 800 tanks.[23] "The Arab nations suffered 17,000 killed or wounded and 8,000

[18] Riney, "Transforming Past Lessons to Mold the Future," 16.
[19] Riney, "Transforming Past Lessons to Mold the Future," 16.
[20] Boyne, "Nickel Grass," 58.
[21] Russell, "Military Airlift to Israel," 80.
[22] Russell, "Military Airlift to Israel," 80.
[23] Russell, "Military Airlift to Israel," 80.

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prisoners, and lost 500 aircraft and 1,800 tanks."[24] The United States, for its part, halted Operation Nickel Grass on 14 November. By then, the U.S. Air Force had delivered 22,395 tons of cargo, requiring 145 missions by the C-5 Galaxy and 422 missions by the C-141 Starlifter.[25]

Oft forgotten when compared to the famous 1948-49 Berlin Airlift, Operation NICKEL GRASS is a watershed event in aerial logistics. Though not resupplying an American presence overseas, NICKEL GRASS restored a balance of power in the Middle East by helping a United States ally survive a coordinated, life-threatening assault from Soviet-backed proxies.[26] Israel's conventional forces failed to deter Egypt and Syria; but the flood of American war-making materiel that filled the ramps at Lajes and Lod helped ensure the survival and territorial integrity of Israel.

Operation NICKEL GRASS proved the concept of global mobility based on jet-powered transport aircraft, and offered several lessons for the air mobility enterprise.[27] Though the United States enjoyed several bases in Europe during the Cold War, only Portugal offered its small field at Lajes to support NICKEL GRASS. Fearing restricted base access for future operations, the United States continued development of air refueling for its fleet of airlift assets. In addition, Colonel Strobaugh's ALCE was fortunate to arrive in a fully mobilized nation facing an existential threat. The motivation and manpower made available to the aerial port in Lod ensured deficiencies in MHE were overcome; and, the ability to locally procure semi-trucks and outfit them with rollers proved essential to speeding the download of aircraft. Logistics manpower limitations and scarce MHE and transport vehicles proved far more problematic when the United States returned to the Middle East in 1990.

Operations DESERT SHIELD and DESERT STORM

[24] Boyne, "Nickel Grass," 58.
[25] Boyne, "Nickel Grass," 59.
[26] Boyne, "Nickel Grass," 59.
[27] Boyne, "Nickel Grass," 56.

On 1 August 1990, Iraqi and Kuwaiti diplomats broke off negotiations over oil pricing, Kuwaiti loans to Iraq, and Iraqi claims on Kuwaiti territory.[28] At dawn the next day, the Iraqi army invaded Kuwait, crumbling Kuwaiti resistance, and taking control of Kuwait City, the nation's capital. "Iraq's rapid and unexpected seizure of all Kuwait gave Saddam Hussein control of 20 percent of the world's oil reserves."[29] An international outcry prompted the United Nations to place an international embargo on Iraq. "U.S. leaders were concerned that Saddam would continue his adventurism by next seizing Saudi oil fields, doubling his percentage of the world's oil reserves, and thereby gaining single-handed control over the world price of oil."[30] Therefore, on 7 August, President George H. W. Bush deployed the first US troops, warplanes and ships to the Persian Gulf region.[31] Termed Operation DESERT SHIELD, the deployment sparked the largest airlift operation to date and most complex military logistical movement since Vietnam. "This operation moved ten times the daily ton-miles of the Berlin Airlift and four times that of the 1973 Operation Nickel Grass.[32] "During the first three weeks of DESERT SHIELD, United States Transportation Command (USTC) moved more passengers to the Persian Gulf than the United States transported to Korea during the first three months of the Korean War. By the sixth week the total ton miles flown surpassed that of the 65-week-long Berlin Airlift."[33] "More than 117,000 wheeled vehicles and 12,000 tanks and armored vehicles deployed and

[28] William Head, PhD, "Air Power in the Persian Gulf," *Air Force Journal of Logistics* 15, no. 4 (Winter 1992), 10.
[29] Robert A. Pape, *Bombing to Win*, (Ithaca, NY: Cornell University Press, 1996), 213.
[30] Pape, *Bombing to Win*, 213.
[31] Head, "Air Power in the Persian Gulf," page 10.
[32] John Lund, Ruth T. Berg, and Corinne Replogle. "Strategic Airlift Operations for the Gulf War: An Assessment of Operational Efficiency." (Santa Monica, CA: RAND Corporation, 1993). xiii.
[33] James K. Matthews and Cora J. Holt, *So Many, So Much, So Far, So Fast*, (Washington, D.C.: Office of the Chairman of the Joint Chiefs of Staff and United States Transportation Command, 1996), 12.

redeployed. More than 1,700 helicopters, 41,000 cargo containers and 350,000 tons of unexpended ammunition went to theater and returned in over 500 ships and 10,000 aircraft sorties. Over 95 million meals served and 2.5 billion gallons of fuel consumed."[34]

Operation DESERT SHIELD and the ensuing mission to expel the Iraqi army from Kuwait, Operation DESERT STORM, represent the culmination of decades of military investment, training, and preparation for large force-on-force engagement—a culmination oft characterized as unqualified military successes. Saudi fears of an Iraqi invasion failed to materialize and the five weeks of precision airstrikes and a 100-hour ground campaign of Operation DESERT STORM successfully decimated the Iraqi military and liberated Kuwait.

The apparent overwhelming success hides truths for students of coercive presence, rapid deployment, and logistics. When was Saddam sufficiently deterred from attacking Saudi Arabia, if that was ever his goal? Was it when the first American forces arrived, or after six months of sustained buildup of combat potential? How effective was the deployment to the Persian Gulf? What limitations in the logistics system prevented the full coercive power of the coalition forces from being realized? To answer these questions, the the initial stages of the deployment are reviewed, highlighting the pitfalls coalition forces faced in deploying to the Persian Gulf. Accounts surrounding the diplomatic effort to coerce an Iraqi retreat are also discussed, drawing attention to the concerted diplomatic, economic, and military pressure from the international community.

The deployment for Operation DESERT SHIELD required unprecedented range, mass, and speed. Iraqi troops continued to mass in Kuwait as diplomatic efforts rallied the U.N. and coalition forces.

[34] Colonel Kenneth Ervin King, "Operation Desert Shield: Thunder Storms of Logistics: Did We Do Any Better During Post Cold War Interventions," Master's thesis, U.S. Army War College, 2007, 5.

Saddam Hussein's troops could have attacked Saudi Arabia at any time. With the Iraqi threat looming, "it made sense to have most of our troops and a large portion of their supplies airlifted to Saudi Arabia from various locations around the world."[35] USTRANSCOM bore the responsibility of creating the "aluminum bridge" over the vast distances to the Persian Gulf. By air it was 7,000 miles from the East Coast and 10,000 miles from the West Coast, with transit by sea adding several thousand miles.[36] But, the speed of airlift complicated the massing of combat-effective presence. United States warfighting doctrine is predicated on air superiority and deep strike; but significant logistical tails accompany the assets necessary to achieve these requirements. Each 24-plane fighter squadron that deployed demanded the equivalent of twenty C-141 airlift cargo loads of up to 70,605 pounds.[37] Army units received the lion's share of their equipment via sealift while every troop would transit to the Gulf via air mobility assets. The burden on lift assets of all types did not halt when those combat forces arrived in theater. Once troops and equipment were in the area of responsibility (AOR), sustainment brought additional logistical burden. For example, a typical armored brigade consumes nearly 1,200 short tons of supplies during a single day in combat.[38] "Just multiplying the water requirements, calculated at 25 liters per person per day, by the hundreds of thousands of troops in-theater provides some measure of the level of the sustainment challenge."[39] Therefore, the DESERT SHIELD deployment involved a balance between concentrating combat-effective

[35] Lt. General William G. Pagonis and Jeffrey L. Cruikshank, *Moving Mountains: Lessons in Leadership and Logistics from the Gulf War,* (Boston, MA: Harvard Business School Press, 1992), 69-70.
[36] Matthews and Holt, "So Many, So Much, So Far, So Fast," page 18.
[37] James Kitfield, "Moving Out," *Government Executive* 22, no. 11 (November 1990), 19.
[38] Major Keith M. Wilkinson, "The Logistics Lessons of the Gulf War: A Snowball in the Desert," paper in partial satisfaction of the requirements of the Department of Operations, Naval War College, 1993, 14.
[39] Wilkinson, "The Logistics Lessons of the Gulf War," page 14.

mass, deploying with the speed, and ranging the vast distances requisite to counter the strident Iraqi threat.

To begin the herculean logistics effort, forces supporting Operation DESERT SHIELD required ports of debarkation and bases for beddown. Cold War plans intended to marry deploying units with forces permanently based in anticipated areas of conflict. Those forward bases and their logistics support routinely exercised the reception of rapid-reaction forces. Forces experienced in exercises to established bases found no such welcome as they arrived in the Persian Gulf. Unlike the Cold War model, this deployment to the Persian Gulf required moving the entire fighting force—air, land, and sea—to an unprepared environment.[40] Decades of strained diplomacy resulted in a region where the United States' presence was extremely limited. "In fact, we had no formal bases anywhere in the Middle East, and except for limited depots in Oman and Bahrain, relatively few prepositioned stocks."[41] With the exceptions of these prepositioned logistics stores—which would become vital to the Operation—the coalition built many of the reception systems from scratch.

Intense negotiations with political and military elites between the United States and the Saudi royal family led the later to offer airbases in Dhahran and Riyadh as aerial ports of debarkation (APOD). As welcome as these bases were to the coalition, initial plans for DESERT SHIELD called for 34 bases to deploy and sustain arriving forces. While negotiations continued to expand APODs in the region, planners assessed those ports of debarkation available to the coalition. The airfield at Dhahran, in the north east corner of Saudi Arabia, was an enormous and modern facility. Dhahran was "plenty close to the

[40] Eliot A. Cohen, director, *Gulf War Air Power Survey: Volume 3, Logistics and Support*, (Washington, D.C., 1993), 81.
[41] Pagonis, *Moving Mountains*, 66.

potential action," according to Lt. Gen. William Pagonis, Director of Logistics for the operation, "in fact, if we'd had a lot of other choices, one could have made the case that they were a little too close to Kuwait and Saddam's forces."[42] In addition to Dhahran, there are three major ports in Saudi Arabia which comprise some of the largest port facilities in the world. Diplomacy and military negotiations ensured unlimited access to and use of the airfields and ports to receive personnel and supplies.[43] Despite the hospitality of the Saudi royal family in the first days of the deployment, too few ports of debarkation existed to support the number of aircraft arriving in Saudi Arabia. However, the size and infrastructure fully at the disposal of the coalition offset much of the burden planners anticipated.

With ports of debarkation selected and a deployment order in hand, MAC launched the first airlift mission of the operation within 18 hours of receiving the "go" signal. A C-141 assigned to the 437th Military Airlift Wing, Charleston Air Force Base (AFB), South Carolina, picked up the Airlift Control Element (ALCE) from McGuire AFB, New Jersey, and started the journey to Saudi Arabia. [44] These forces bore the initial burden of receiving the incoming combat forces. At the same time, members of the 1st Tactical Fighter Wing at Langley AFB, Virginia and 82d Airborne division watched as fighters and mobility aircraft the launched both units to their deterrent positions short of the Kuwaiti border. [45]

As troops and aircraft flew to the region, mothballed prepositioned supplies in the region and on the seas prepared for use. Most of the initial sustainment and infrastructure supplies came from prepositioned stores. Prepositioned stores in Oman and Bahrain contained limited

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[42] Pagonis, *Moving Mountains,* 69-70.
[43] Pagonis, *Moving Mountains*, 71.
[44] Matthews and Holt, "So Many, So Much, So Far, So Fast," 38.
[45] Kitfield, "Moving Out," 18.

equipment and fuel. Additional materiel was stored aboard maritime prepositioned ships (MPSs). "These ships are moored in several strategic locations for reasonably rapid deployment to military hotspots, especially where the United States has few other resources to draw upon."[46] MPSs primarily provided munitions, but also provided housing, sustenance, and some vehicles critical to receive the host of forces en route via airlift. Even before the deployment order was signed, six MPSs (two Air Force, primarily carrying ammunition; and four Army) were mobilized. They constituted the first significant stock of supplies in-theater.

> Each ship contained at least the bare minimum of almost every imaginable item needed to support a "baseless" army in the field. These supplies included, for example: small arms ammunition and 32,500 hand grenades, 16 bread ovens and 3,000 land mines, and 5.5 million gallons of jet fuel. The [MPSs] carried cranes, refrigerated vans, and forklifts. They carried machine guns, mortar rounds, 6,000 sleeping bags, uniforms and coveralls, and seven field laundry units; 124,000 Class-1 rations (MREs), and fuel bars for heating other kinds of food; medical supplies, cots, blankets, tents, stencil machines, microfiche viewers, file cabinets and radio units; and countless other items.[47]

The prepositioned equipment and munitions provided an initial boost to the war-fighting effort. The MPSs reportedly saved over 1,800 airlift missions. [48] Any relief on the strained airlift operations proved critical, for the initial phase of the deployment exceeded MAC's organic airlift capacity by a factor of six or seven.[49]

On 8 August, the C-141 carrying the first ALCE arrived at Dhahran. Several hours later, Lt Gen Pagonis and his staff moved to Dhahran to inspect the airfield. He recounts, "There were already thousands of American troops on the ground, standing, sitting or milling

[46] Pagonis, *Moving Mountains*, 71.
[47] Pagonis, *Moving Mountains,* 70-71
[48] Major Stephen J. Hagel, "Capturing Logistics Data, Part II," *Air Force Journal of Logistics* 16, no. 1 (Winter 1992), 2.
[49] Cohen, *Gulf War Air Power Survey*, 82.

around. Every few minutes another transport plane would arrive, pouring hundreds more soldiers into ever-denser knots around the runway. Shelter from the blazing sun was almost impossible to find, and in the few places where a building or aircraft threw off some shade, soldiers jockeyed for position."[50] Still wary of the threat of a pending Iraqi invasion of Saudi Arabia, General Schwarzkopf concluded that deploying combat forces took priority. The small logistics forces already in country would receive meager additional support in the following days. Consequently, logisticians relied heavily on prepositioned equipment and host-nation support.

Unfortunately, the state of prepositioned equipment was not always up to the task. First, prepositioned materiel was not released to the APODs by the CENTCOM staff for two weeks, since neither that staff nor the forces on the ground understood where best to place the precious assets.[51] Second, many of the vehicles and MHE were found to break after only a few hours or days.[52] "Some of this was attributed to the climate, some to shipping, and some to neglect."[53] In many cases, vehicles were broken and required maintenance to make them work again.[54] Certainly not all of the prepositioned materiel and equipment was inoperable; however, any degradation in capability magnified logistical problems at the scarce ports of debarkation.

Several specific MHE capabilities limited throughput at Dhahran. The quantity and especially quality of material handling equipment (MHE) complicated offload operations in theater.[55] MAC's 40K loader, the standard download equipment for military transports, was procured in the 1960s and showed its age rapidly. In the dry, gritty, sandy climate

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50 Pagonis, *Moving Mountains,* 85.
51 Cohen, *Gulf War Air Power Survey*, page 106.
52 Hagel, "Capturing Logistics Data," 4.
53 Hagel, "Capturing Logistics Data," 5.
54 Hagel, "Capturing Logistics Data," 4.
55 Matthews and Holt, "So Many, So Much, So Far, So Fast," 75.

of the Persian Gulf, seals and gaskets failed at an alarming rate.[56] Forklifts and wide body loaders—necessary to download KC-10 and civilian aircraft—were also in short supply, as were the spare parts available to repair these assets when they broke down.[57] Aerial-port personnel routinely had 50 percent of their MHE working at a time, leading to a backlog of up to 1,300 pallets at one point.[58] In addition, fuel for aircraft supporting the "aluminum bridge" limited potential throughput at Dhahran. "Not enough fuel pits, fuel trucks. or drivers were available. Once the problem was recognized, CENTCOM sent a storage system and fuel trucks to Dhahran."[59] Only after the trucks arrived was it discovered that couplings on the truck and the Saudi fuel pits did not match.[60] During the first few critical weeks of the deployment, the commander of airlift forces in the AOR reported that MHE availability and refueling capacity were the primary constraints limiting the number of aircraft allowed on the ground at Dhahran.[61]

While waiting for relief from prepositioned stores and MHE from the United States and Europe, logisticians turned to the Saudis for support. This support was not reserved merely to MHE. The entire ready brigade of the 82nd Airborne reached Dhahran on 8 August, without basic housing or follow-on transport capabilities. To relieve the gap in housing until MPS sustainment could catch up, contracting personnel immediately set about securing 10,000 Bedouin tents, and hired dozens of third-country nationals to come in and erect them.[62] Thousands of soldiers and tons of supplies stacked up at both sea and air ports of debarkation. Consequently, Military and political leaders

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[56] Matthews and Holt, "So Many, So Much, So Far, So Fast," 75.
[57] Hagel, "Capturing Logistics Data," 6.
[58] Hagel, "Capturing Logistics Data," 6.
[59] Cohen, *Gulf War Air Power Survey*, 101.
[60] Cohen, *Gulf War Air Power Survey*, 101.
[61] Matthews and Holt, "So Many, So Much, So Far, So Fast," 75.
[62] Pagonis, *Moving Mountains,* 88.

leaned on the Saudi royal family to make fleets of buses, trucks, and heavy-equipment transporters available. In addition, the Saudis authorized priority access to the Kingdom's limited road network."[63] Eventually, every car, truck, and bus available in Saudi Arabia was under contract. Despite this herculean contracting effort, subsequent transport gaps continued until the end of the Operation.[64]

Despite these logistical challenges forces supporting Operation DESERT SHIELD faced, the build-up of combat power continued. After 22 days, the entire 82nd Airborne Division was in Saudi Arabia.[65] By the end of August, two Navy carrier battle groups, two Army brigades, and five Air Force fighter squadrons deployed to the theater while an Air Force strategic bomber wing readied for operations on the British isle of Diego Garcia.[66] Once sufficient combat power existed in northern Saudi Arabia, the priority of incoming cargo and troops became more flexible.[67] Additional logistics forces and equipment made their way to the theater. New throughput challenges emerged during the buildup of forces prior to the start of Operation DESERT SHIELD, but these challenges remained of the same character as the problems outlined above.

In sum, the deployment supporting Operation DESERT SHIELD was the fastest buildup of conventional force in history.[68] Basing dilemmas, aging and broken MHE, and throughput limits severely constrained the deployment of Operation DESERT SHIELD. Ports of debarkation were consistently congested, hampering the combat effectiveness of deploying forces and offering tantalizing targets should the Iraqi regime decide to strike. The oppressive desert environment

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[63] Pagonis, *Moving Mountains,* 71-72
[64] Pagonis, *Moving Mountains,* 105
[65] Wilkinson, "The Logistics of the Gulf War," 9.
[66] Matthews and Holt, "So Many, So Much, So Far, So Fast," page 19.
[67] Pagonis, *Moving Mountains,* 125.
[68] Cohen, *Gulf War Air Power Survey,* page 138.

wreaked havoc on heavy equipment and vehicles, further restricting an already restricted logistics flow.

However, many factors worked in the coalition's favor. An absence of ports of debarkation and deficiency in troop and cargo transports were mitigated by access to modern, if ill-equipped, air and sea ports. After reviewing Saudi capacity, seasoned logistician Lt. Gen Pagonis noted, "If you had to have a war…this would be a great place to have it."[69] Abundant resources, negotiated multiplication of ports of debarkation, and time allowed the coalition to overcome the logistical challenges of deploying to fight in a region relatively devoid of allied presence. The ability to mobilize military presence, coupled with diplomatic and economic pressure, deterred Iraq from furthering its expansion into Saudi Arabia. Saddam Hussein proved his willingness to employ military power to achieve desired ends. His fait accompli in Kuwait granted him immense potential for economic gain via oil reserves and influence over price-per-barrel. Saddam repeatedly reassured his neighbors that the military build-up on the Iraqi southern border was not a prelude to invasion. Saddam lied. King Fahd of Saudi Arabia watched with trepidation as four divisions of Iraqi tanks building up at the Saudi border in a flat desert area that Saudi Prince Bandar had described as a "superhighway for tanks" leading directly to the kingdom's vast oil fields.[70] Although Saddam attempted to reassure both Saudi and international audiences that his expansionary designs stopped with Kuwait, the Saudi royal family petitioned the United States for military support. We do not know with certainty if Saddam's expansionary desires included the northern Saudi oil fields. However, we do know that he did

[69] Pagonis, *Moving Mountains,* 71.
[70] Douglas Frantz, "Saudi Leaders Feared They Were Next Target : Invasion: Ambassador to U.S. describes his nation's 'window of vulnerability,'" *Los Angeles Times*, August 12, 1990. (http://articles.latimes.com/1990-08-12/news/mn-1042_1_saudi-arabia)

not attempt to take these fields once coalition military presence stood in his way. During the first few days of the deployment, coalition forces were insufficient to halt his advance. Despite their limited combat power, it is possible that these forces altered the risks Saddam had to weigh before continuing escalation. Overrunning United States forces likely risked the gains in Kuwait Saddam expected to consolidate short of a protracted ground war. With the exception of a relatively small incursion at Khafji, after Coalition forces commenced air strikes, Saddam refrained from serious efforts to advance into Saudi Arabia. One of the primary goals of Operation DESERT SHIELD—protecting Saudi Arabia from a potential Iraqi invasion—was achieved through the rapid deployment of military presence, sustained diplomatic pressure, and significant economic sanctions.

On the other hand, this cumulative coercive strategy seems to have failed to drive Iraqi forces from Kuwait. Saddam Hussein rejected calls to pull out of Kuwait because he believed American air power posed little threat to his forces or regime, and the United States could not stomach the casualties of the ground war necessary to drive him from Kuwait when air strikes failed.[71] "Shortly after invading Kuwait, he declared, 'The United States relies on the Air Force and the Air Force has never been a decisive factor in the history of wars.'"[72] Consequently, Saddam rebuked calls for him to withdraw from Kuwait. According to Robert Pape, "everyone agrees that Iraq remained firmly opposed to withdrawal from Kuwait from the time of the invasion on 2 August 1990 to the start of the air war on 16 January 1991."[73] Though coalition forces successfully deterred Iraq, neither their presence—nor the influence of diplomacy or economic sanctions—compelled Saddam to withdraw.

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[71] Byman, Waxman, and Larson, *Air Power as a Coercive Instrument*, 50.
[72] Byman, Waxman, and Larson, *Air Power as a Coercive Instrument*, 51.
[73] Pape, *Bombing to Win*, 213.

On 17 January 1991, the Coalition commenced air strikes on Iraq's command and control, leaderships facilities, and fielded forces. While some debate surrounds which targets eventually altered Saddam's strategic calculus, what is clear is that Iraq soon sought a diplomatic solution that included its withdrawal from Kuwait. On 11 February, Russian envoy, Yevgeni Primakov, met with Saddam Hussein in Baghdad. At that meeting, Saddam "accepted Primakov's proposal that Iraq withdraw from Kuwait without economic or territorial compensation…"[74] "On 21 February Moscow announced that Saddam had accepted the Soviet plan for Iraq's 'full and unconditional withdrawal' from Kuwait."[75] At this point, Saddam was effectively beaten.

However, the United States quickly denounced the Soviet-brokered deal, claiming it too soft because it lacked a timetable for withdrawal and ended economic sanctions prematurely.[76] The United States now demanded that Iraq leave its military equipment behind, destroying Iraq's offensive military capability to ensure "future regional stability." [77] Saddam Hussein refused and the coalition invaded. However, the facts show that Saddam was prepared for a full and unconditional withdrawal from Kuwait. Devastating air strikes and an impending ground offensive, when combined with diplomatic and economic pressure, successfully coerced the Iraqi regime.

To conclude, the presence of military forces might have deterred Iraq from invading Saudi Arabia. If Saddam contemplated further expansion, the rapid deployment of military presence may have altered that decision calculus. Those initial forces, however, enjoyed meager combat capability for the first few weeks of Operation DESERT STORM.

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[74] John Andreas Olsen, *John Warden and the Renaissance of American Air Power,* (Washington, D.C.: Potomac Books, Inc., 2007), 231.
[75] Pape, *Bombing to Win*, 216.
[76] Pape, *Bombing to Win*, 217.
[77] Pape, *Bombing to Win*, 213-214.

This paper has been cleared for public release by AU Security and Policy Review Office.

Saddam allowed the Coalition five and a half months to deploy sufficient combat power to adopt a compellent strategy. Airstrikes and the threat of massive ground invasion—in concert with other instruments of power—eventually compelled Saddam to withdraw from Iraq.

Unfortunately, future adversaries watched the events of Operation DESERT SHIELD and DESERT STORM with interest. Could the United States successfully compel future adversaries without sufficient time and capacity to deploy large forces to a contested theater? Eight years later, the United States tested its deployment capacity again; and, again, strategic success masked similar flaws in American logistics capabilities.

Task Force Hawk

In 1999, the North Atlantic Treaty Organization (NATO) chose to intervene and halt ethnic hostilities between Slobodan Milosevic's Serbian forces and ethnic-Albanian Kosovars. The introduction took form as Operation ALLIED FORCE (OAF). This operation, though heralded for its coercive success, received much criticism for the time required to pacify the region. Following the quick airpower victory of Operation DELIBERATE FORCE in 1995, many political and military leaders believed "that two to four days of NATO bombing would suffice to alter the behavior of Slobodan Milosevic…"[78] "Instead of a three-day operation, NATO ended up bombing the [Federal Republic of Yugoslavia], mainly Serbia , for seventy-eight days."[79] While air strikes effectively eliminated fixed targets with ease, Serbian forces dispersed into company- and battalion-sized battle groups amid the forested, hilly terrain, rendering them effectively invisible from air assets overhead.[80] Consequently, air attacks had done little to halt ethnic cleansing.

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[78] Dag Henrickson, *NATO's Gamble,* (Annapolis, MD: Naval Institute Press, 2007), Introduction page 2.
[79] Henrickson, *NATO's Gamble,* Introduction page 2.
[80] John Gordon IV, Bruce Nardulli, and Walter L. Perry, "The Operational Challenges of Task Force Hawk," *Joint Force Quarterly* (Autumn/Winter 2001-2002), 53.

Accordingly, military and civilian leaders recognized the need to raise "the specter of ground combat to a degree that caused Serbian leaders to notice."[81]

That specter was Task Force Hawk. Task Force Hawk's planned role was to use AH-64 Apache helicopters and multiple launch rocket system (MLRS) to hit Serbian fielded forces in Kosovo. General Clark "intended for the rocket (MLRS) and tube (155-mm howitzers) artillery of Task Force Hawk to pave the way for Apache deep strikes against dispersed Serbian armored forces throughout Kosovo."[82] Despite the fact that the Apaches would never fire their weapons in combat, the Task Force played a critical role in making NATO's coercive strategy a success. That success overshadows fundamental problems, however, surrounding the deployment of Task Force Hawk.

Given the short distances most forces moved, the forty-nine days required to close Task Force Hawk's deployment appears uncommonly long. "The majority of [Task Force] Hawk's units were based in Germany as part of the forward presence forces of U.S. Army Europe."[83] Gen Wesley Clark first considered employing attack helicopters as a part of OAF on March 20, 1999, "just four days prior to the start of NATO air attacks."[84] On April 1, General Clark briefed the plan to deploy the Apaches to the Secretary of Defense and all the service chiefs; and, on April 4, President Bill Clinton signed the deployment order. [85] Initial estimates indicated it would take up to 10 days to deploy the package.[86] "In the end, it took seventeen days just to field the first battalion of

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[81] Robert H. Gregory Jr., *Clean Bombs and Dirty Wars,* (Potomac Books, 2015), 56.
[82] Gregory, *Clean Bombs and Dirty Wars*, 90
[83] Lt Commander Cynthia M. Womble, "Task Force Hawk: Operational Mobility Lessons for the Joint Force Commander," Paper submitted to Department of Joint Military Operations, Naval War College, 2001, 3.
[84] Gordon, Nardulli, and Perry, "The Operational Challenges of Task Force Hawk," 53.
[85] Gregory, *Clean Bombs and Dirty Wars*, 88.
[86] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment*, (Santa Monica, CA: RAND, 2001), 148.

Apaches and another thirty-two to move the massive force the Army cobbled together to support the Task Force.[87]

One reason for the delayed deployment timeline was the swelling in size and composition of the Task Force due to a change in deployed location. Usually, an Apache battalion deploys only as part of a larger Army division or corps, with all of the latter's organically attached elements.[88] Initially preparing to deploy to Macedonia, Task Force Hawk planners anticipated taking advantage of in-place facilities and infrastructure already in Macedonia to speed the deployment and provide the standard support Apache battalions require. But Macedonia refused to accept Task Force Hawk, "citing the 1995 Dayton Accords which prohibited basing 'offensive forces' along the boundaries of the former Yugoslavia."[89]

Luckily, Albania agreed to base the Task Force at an airfield near Tirana; however, the new location severely complicated deployment planning. The first fundamental issue was force protection. "Army planners had to be concerned about the inherent risks of deploying…Apaches on terrain that was not that of a NATO ally…." [90] Moreover, Albania lacked any semblance of a friendly ground-force presence, raising fears of a [Serbian army] cross-border attack in the absence of ground forces sufficient to render such an attack an unacceptable gamble for [Serbian] commanders.[91] Therefore the total deployment package grew to include:

> The two battalions of Apaches and 26 UH-60 Black Hawk and CH-47D Chinnook helicopters from the 12th Aviation Regiment at Wiesbaden, Germany. Additonal assets whose deployment was deemed essential for

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[87] Lambeth, *NATO's Air War for Kosovo,* 148.
[88] Benjamin S. Lambeth, "Task Force Hawk," *Air Force Magazine* 85, no. 2 (February 2002), 79-80.
[89] Gregory, *Clean Bombs and Dirty Wars*, 89
[90] Lambeth, "Task Force Hawk," 80.
[91] Lambeth, "Task Force Hawk," 79-80.

> supporting the Apaches included a light infrantry company; a MLRS platoon and three MLRS vehicles, a high-mobility multipurpose wheeled vehicle (Humvee) anti-tank company equipped with 38 armed utility vehicles; a military intelligence platoon; a military police platoon; and a combat service support team. The Army further determined a need for its Apaches to be accompanied by a mechanized infantry company equipped with 14 Bradley armored fighting vehicles; an armor company with 15 M1A2 Abrams main battle tanks; a howitzer battery with eight 155 artillery pieces; a construction engineer company; a short-range air defense battery with eight more Bradley armored fighting vehicles armed with Stinger infrared surface-to-air missiles; a smoke generator platoon; a brigade headquarters complement; and diverse other elements. In all, to backstop the deployment of 24 attack helicopters to Albania, Task Force Hawk ended up being accompanied by a support train of no fewer than 5,350 Army personnel.[92]

Further complicating Task Force Hawk's deployment, the airbase in Albania was ill-suited to handle the logistics burden of such a large unit. Tirana, the best option available to planners in Albania, had "poor rail connections, a shallow port, and a limited airfield capacity that could not accommodate the Air Force's C-5 heavy airlifter."[93] This required the Task Force to airlift in whatever it brought to Albania via the new C-17 Globemaster III airlifter. While the C-17 ensured Task Force Hawk had access to the airfield, the absence of supporting infrastructure on the ground constrained an already taxed throughput capacity.

Luckily, on the same day that President Clinton signed the Task Force's deployment order, the 86th Contingency Response Group (CRG) from Ramstein Air Base embarked to Tirana to augment ongoing humanitarian operations providing relief to refugees fleeing Kosovo. "Previously, the airfield had only 10 arrivals and departures per day.

[92] Lambeth, "Task Force Hawk," 79.
[93] Lambeth, "Task Force Hawk," 83.

Within a few short weeks, under the 86th CRG's leadership, there were over four hundred takeoffs and landings per day."[94] The CRG augmented air traffic control, upload and download of cargo, communications, and security at the airfield.[95]

In addition, the construction battalion added to Task Force Hawk also proved critical to the deployment. There was limited ramp room in Tirana for cargo aircraft and, unfortunately, torrential rains had turned the surrounding area into a lake of mud. Humanitarian relief helicopters looking for a place to offload their cargo began landing in open fields and rapidly sunk up to their bellies.[96] Recognizing the space issues would not improve, the construction battalion constructed concrete landing pads prior to the Apache's arrival, but logistics equipment was in short supply at Tirana.

In sum, adding force protection, infrastructure, and support to the size of Task Force Hawk ballooned the logistics requirements by a factor of three.[97] Initial estimates anticipated "200 USAF C-17 transport sorties would be needed to airlift the assorted support elements with which the Apaches had been burdened."[98] In practice, "it took more than 500 C-17 sorties, moving some 22,000 short tons in all, to transfer Hawk in its entirety."[99]

At the time President Clinton signed the Task Force's deployment order, Department of Defense spokesperson Kenneth Bacon announced that Task Force Hawk would take ten days to deploy.[100] In reality, the Task Force Hawk required 38 days from verbal warning order to initial

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[94] General John P. Jumper, "Rapidly Deploying Aerospace Power," *Aerospace Power Journal* 13, no. 4 (Winter 1999), 8.
[95] Jumper, "Rapidly Deploying Aerospace Power," 8.
[96] Gordon, Nardulli, and Perry, "The Operational Challenges of Task Force Hawk," 54.
[97] Womble, "Task Force Hawk," 3.
[98] Lambeth, "Task Force Hawk," 80.
[99] Lambeth, "Task Force Hawk," 80.
[100] Gregory, *Clean Bombs and Dirty Wars,* 89.

mission capability for deep operations.[101] "The final force package completed deployment eleven days later bringing the total to 49 days."[102] "As of May 31, the cost of the Task Force Hawk deployment had reached $254 million, much of that constituting the expense for the hundreds of C-17 sorties that had been needed to haul all the equipment from Germany to Albania, plus the additional costs of building base camps and port services …"[103]

Several questions emerge from the foregoing account. First, was the cost and effort required to deploy Task Force Hawk worth it? Since the Task Force never conducted kinetic operations, was it useful as a coercive instrument? On 22 April 1999, Milosevic seemed confident in his army: "Let them just try to stick their noses in here!" he said. "A [NATO] ground operation will definitely fail.[104] After NATO started hitting actual artillery tubes rather than decoys—due to Task Force Hawk's counter-battery radars—Milosevic lost confidence in the ability of the Serbian army to repel NATO forces.[105] The threat of a NATO ground invasion occurring at some indeterminate time in the future had ominous implications for Milosevic. Such an invasion "could have meant Serbia's loss of Kosovo for good, posing a direct threat to Milosevic's survival."[106] There is every reason to believe that Task Force Hawk's deployment, "along with NATO's subsequent decision to enlarge the Kosovo peacekeeping force (KFOR) to as many as 50,000 troops, was assessed by Milosevic as an indication that a NATO ground option was at least being kept open."[107] Serbian force posture adds further evidence to Task Force Hawk's impact. In mid-May, Serbian units were reported to

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[101] Womble, "Task Force Hawk," 3.
[102] Womble, "Task Force Hawk," 3.
[103] Lambeth, "Task Force Hawk," 80.
[104] Boris Yeltsin, *Midnight Diaries,* Translated by Catherine A. Fitzpatrick, (New York, NY: Public Affairs, 2000), 263-264.
[105] Gregory, *Clean Bombs and Dirty Wars,* 213.
[106] Lambeth, *NATO's Air War for Kosovo*, 81.
[107] Lambeth, *NATO's Air War for Kosovo*, 72.

be digging in along likely attack routes from Albania and fortifying the border.[108] This suggests Milosevic was shifting his focus in the region from expelling ethnic Albanians to preparing for a possible showdown with NATO on the ground.[109] Of course, it is impossible to know exactly what was going on inside Milosevic's head, but his orders to forces in Kosovo are telling. Ultimately, the timing of his decision to concede after such a substantial NATO ground force deployment, and subsequent integration of those forces into joint targeting, suggests the presence of Task Force Hawk impacted Milosevic's calculus.[110] Unsurprisingly, "Milsosevic's position changed. He no longer wanted an escalation of the conflict. He asked to stop the war."[111]

Though the presence of Task Force Hawk contributed to NATO's coercive strategy, what trends do the deployment of its forces offer students of logistics? Land and sea lines of communication into and out of Albania were inadequate, driving the logistics effort to the air. While the United States' air mobility assets can swiftly range the globe, the limited weight capacity of aircraft drives sortie requirements—and costs—up for large force movements.

Even if airbases exist, they may be incapable of receiving a massive military force. When confronted with such a situation in Tirana, Task Force Hawk required augmentation from the Contingency Response Group (CRG)—to increase air traffic control capacity, augment upload/download capabilities, and provide initial communication assets for incoming forces. In addition, the lack of sufficient parking drove Task Force Hawk to bring along its own construction battalions. Finally, Tirana posed significant force-protection issues. Although the Task Force was initially planned as a deep-strike force, the threat of Serbian

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[108] Lambeth, *NATO's Air War for Kosovo*, 73
[109] Lambeth, *NATO's Air War for Kosovo*, 73
[110] Gregory, *Clean Bombs and Dirty Wars,* 213.
[111] Yeltsin, *Midnight Diaries,* 264.

ground attack drove planners to add thousands of troops and battalions of combat vehicles to ensure sufficient defense. These forces did not bring only their support capabilities, they also brought additional requirements for beddown and sustainment. All of these requirements compounded the sortie obligations, cost, and throughput requirements necessary to move Task Force Hawk.

Conclusion

Conventional coercion has an uneven history. Despite consistently demonstrating dominant military might, Egypt and Syria were not deterred by Israel's conventional forces—the presence of permanent Israeli conventional forces failed to halt an Arab attack. But, even when deterrence failed, rapid resupply ensured the Israelis could re-establish their military presence to pre-war lines. The Yom Kippur War case does not suggest that conventional forces are incapable of coercing adversaries. In fact, the movement of forces to a contested region bolstered comprehensive coercive campaigns in Operation DESERT SHIELD and the Kosovo War. Economic sanctions and diplomatic efforts, when tied to airstrikes and the introduction of ground forces sufficient to attack the Iraqi and Serbian armies, convinced Saddam Hussein and Slobodan Milosevic that they could not sustain ethnic cleansing in Kosovo or occupy Kuwait, respectively.

Collectively, these cases offer several lessons with regard to conventional presence. First, permanently stationed forces are not a panacea for deterrence; but, in those cases where conventional coercion fails, rapid deployment and resupply is critical to ensure the sustainment of those forces. Second, deployable ground-force presence can influence the decisions of adversaries. Finally, tyrannies of distance and time make deploying and sustaining forward presence difficult—to say the least.

The logistics challenges encountered by Operation NICKEL GRASS, Operation DESERT SHIELD, Operation DESERT STORM, and Task Force Hawk are common. Contingencies around the globe often emerge in locations with brittle infrastructure, scarce logistics hubs, and inadequate lines of transit. Over time, it is cheaper and easier for America's adversaries to hold permanent forward bases at risk than it is for the United States to defend them.[112]

If these challenges are so routine, what has the United States done to mitigate them? The Yom Kippur war demonstrated a need for air-refuelable airlift assets and prepositioned ships to provide materiel to regions without permanent United States presence. The C-5 and C-17 aircraft proved crucial to both the Gulf War and the deployment of Task Force Hawk. Prepositioned equipment proved vital to Operation DESERT STORM, but the prepositioned concept has limitations. As is evidenced by both Operation DESERT SHIELD and the BIG LIFT, storing generic vehicles without sufficient maintenance can add significant man-hours, maintenance personnel, and parts in order to make the prepositioned assets operationally capable.

If—as these historical cases demonstrate—military presence and the current capacity to sustain that presence can be sufficient to coerce adversaries, why should the United States invest in eliminating constraints on military logistics. The answer is that future wars may not be preceded by months to prepare—speed might be paramount.[113] Potential rivals of the United States witnessed the massive resupply of the Yom Kippur War, the overwhelming coalition victory of Operation DESERT STORM, and the coercive success of the war in Kosovo. These accomplishments demonstrate that American kinetic and logistics

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[112] Lynn E. Davis, Stacie L. Pettyjohn, Melanie W. Sisson, Stephen M. Worman, and Michael J. McNerney, *U.S. Overseas Military Presence: What are the Strategic Choices*, (Santa Monica, CA: RAND, 2012), 34.
[113] Cohen, *Gulf War Air Power Survey*, 391.

superiority translate to battlefield success. Given the time necessary to overcome the well-established logistics challenges outlined in these historical reviews, the United States can employ military presence as a part of coercive strategies. But impediments exist. Adversaries of the United States learned these lessons, and should be expected to exploit these logistical constraints on American power projection.

Additionally, the logistics vulnerability of the United States is likely to increase. As the logistics tail of armies grows with the technical sophistication of those forces, and the United States chooses to reduce (or is asked to leave) permanent fixed bases abroad, the ability to deploy forces rapidly presents an ever-expanding vulnerability to American power projection.

The question, then, is what should the United States do to mitigate this vulnerability?

CHAPTER 4

CURRENT TECHNOLOGIES, FORCES, AND CONCEPTS OF OPERATIONS

The previous chapter described the deployments and sustainment of forward presence. In each case, the Airlift Control Elements (ALCEs), wide-body elevator loaders, or improvised roller trucks played critical roles in these narratives. The historical impact of these forces and equipment suggests a review of the current state of logistics technology, forces, and concepts of operations. Beginning with a brief review of the standard equipment used to download aircraft, the chapter turns to an exhaustive examination of how the Department of Defense (DOD) plans aerial logistics. Through this examination, maximum-on-ground (MOG) emerges as the critical constraint in the throughput equation. Furthermore, the limits and capabilities of the current forces deliberately developed to expand MOG at expeditionary airfields—contingency response forces—are explored.

Current Logistics Technologies

The current load/off load equipment—or MHE—employed by the DOD sets a high standard for expeditionary capability, and can be divided into two fundamental categories. The first—forklifts—is quite diverse; however, the primary expeditionary forklift is the 10K All-Terrain Forklift (ATFL). The ATFL is a versatile forklift with a ten-thousand-pound capacity and is configurable for air transport on the venerable C-130 after minimal break-down. While extremely robust, the ATFL is nothing more than a large, ruggedized forklift—technology that has existed for nearly a century.[1]

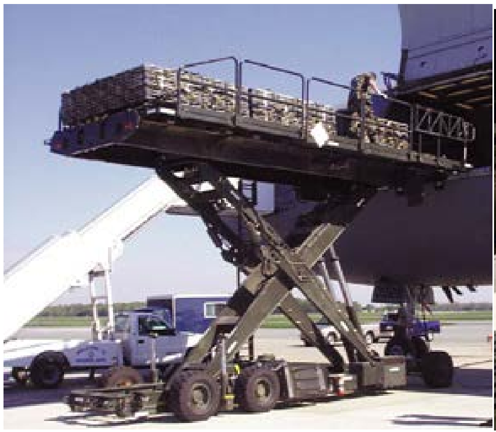
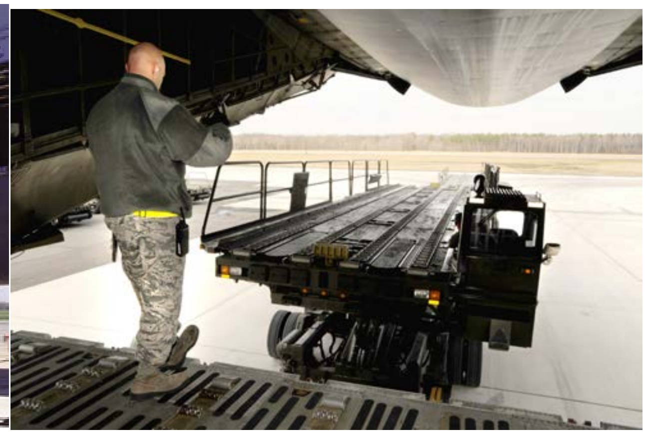
[1] Material Handling Equipment Distributors Association, "Forklift Trucks— The Backbone Of The Industry," http://www.themhedajournal.org/content/3q04/lifttrucks.php.

Figure 1. 10K All-Terrain Forklift
Source: http://www.jointbasemdl.af.mil/news/story.asp?id=123221453.

The second category of MHE—loaders—also enjoys a wide variety of size and capability. Starting with the smaller of the two, the 25K *Halvorsen*, so named for the weight it can carry, first entered service in 2001 to replace the aging 25K loaders and wide-body elevator loaders in service since the 1960s. The older 25K loaders could not raise their loading decks high enough to download many civilian aircraft, thus requiring aerial port operations to augment with wide-body elevator loaders to ensure most civilian and military aircraft could be loaded. With notoriously low cargo handling capacity, AMC's older wide-body elevators drove significant delays in aerial port operations.[2] With the development of the 25K *Halvorsen*, which can lift its deck to a height of of 18 feet, this single piece of equipment supports cargo handling operations on some of the largest commercial aircraft, such as the Boeing 747 and DC-10.[3] Additionally, eliminating the need to deploy the wide-

[2] Federation of American Scientists, "60K *Tunner* Material Handling Equipment", 15 February 2000, http://fas.org/man/dod-101/sys/ac/equip/tunner.htm.
[3] Air Mobility Command, "Halvorsen Loader," http://www.amc.af.mil/library/factsheets/factsheet.asp?id=236

body elevator loaders significantly decreases lift, maintenance, and training requirements for aerial port forces.

Figures 2 & 3. 25K *Halvorsen* & 60K *Tunner*
Sources:
http://www.amc.af.mil/library/factsheets/factsheet.asp?id=236. & http://www.dover.af.mil/photos/mediagallery.asp?galleryID=1384&?id=-1&page=5&count=48.

Much like the *Halvorsen*, the introduction of the 60K *Tunner* in 1997 sought to eliminate aging 40K loaders which also required augmentation from wide-body elevator loaders.[4] While the *Halvorsen* and *Tunner* are capable of loading and unloading wide-body aircraft, the *Tunner* can download a C-17's full load of 18 pallets in three passes.[5] For comparison, "a 25K would require at least six passes…" to complete the same job.[6] In addition, the *Tunner*'s hydraulically adjustable suspension allows the loader on or off the C-5 or C-17 airlifters for air transport.[7]

While the deck height, speed, and ruggedization of modern material-handling equipment are far superior to its predecessors, these

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[4] Air Mobility Command, "Tunner 60K Loader," 29 December 2011, http://www.amc.af.mil/library/factsheets/factsheet.asp?id=242
[5] Federation of American Scientists, "60K *Tunner* Material Handling Equipment."
[6] Federation of American Scientists, "60K *Tunner* Material Handling Equipment."
[7] Air Mobility Command, "Tunner 60K Loader."

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pieces of equipment do not constitute a revolution in military logistics. As mentioned, the expeditionary capabilities of the ATFL are extensive, but are merely the "ruggedization" of relatively old forklift technologies common to logistics for the past hundred years. Similarly, the *Halvorsen* and *Tunner* have increased air transport roll-on/roll-off capacity and the ability to download wide-body aircraft—significant innovations for expeditionary operations. These improvements, however, may approach the limits of speed, capacity, and "ruggedization" of forklift technologies. Technical improvements in the future must explore other opportunities for innovation.

MHE technologies are one piece to the orchestra of aerial logistics. The cargo capacity and load/offload capability of airlift aircraft themselves are also instrumental to this enterprise. The DOD has three dedicated airlift aircraft: the C-130 *Hercules*, the C-17 *Globemaster III*, and the C-5 *Galaxy.* The primary theater airlifter is the C-130. Specializing in austere airfield operations and airdrop, C-130s have 6-8 pallet positions and an Allowable Cabin Load (ACL) of 17-22 short tons per aircraft.[8] C-17s, the largest airlifters with austere field and airdrop capabilities, have a capacity of 18 pallets and an ACL of up to 65 short tons.[9] With by far the most lift capacity but commensurate inability to operate at austere airfields, the C-5 has a capacity of 36 pallets and up to 89 short tons.[10]

According to Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, the physical capacities outlined above translate into estimated durations for the upload, download, enroute refuel, or expedited ground operations for each aircraft. Particularly germane to this analysis of the rapid deployment of forces are the "expedited" timelines detailed in this

[8] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors,* 12 December 2011, table 3, 12.
[9] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, table 3, 12.
[10] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, table 3, 12.

document. By expedited, the pamphlet claims an aircraft can be expected to finish either a complete download *or* upload in the time allotted.[11] Furthermore, expedited timelines do not include time for refuel or reconfiguration of the cargo compartment of the aircraft. In essence, expedited timelines are the temporal factor logisticians anticipate when planning aerial port throughput. The expedited upload or download time is forty-five minutes for C-130s, an hour and fifteen minutes for C-17s, and two hours or more for C-5s and other wide-body aircraft.[12]

These weights limits, pallet capacities, and expedited download times represent dramatic jumps in cargo aircraft capacity and efficiency over the past 70 years. However, just like forklifts and cargo loaders, these improvements are merely increases in scale on fundamentally evolutionary technologies and, again, do not represent a revolution in technology.

The Math of Logistics

Returning to Air Force Pamphlet 10-1403: *Air Mobility Planning Factors*, one of the document's most important equations is airfield throughput capability, which is expressed:[13]

$$= \frac{(MOG)\times(Avg\ Payload)\times(Operating\ Hours)}{(Ground\ Time)} \times (85\%\ Queuing\ Efficiency)$$

This equation allows logisticians to plan the amount of cargo and personnel that can transit through a logistics node. Mathematically, increasing Maximum on Ground (MOG), average payload of aircraft, or the operating hours of an airfield increase throughput. Conversely, decreasing ground time increases potential throughput. The 85% queuing efficiency—"a factor used by planners and applied in formulas to account for the physical impossibility of using limited airfield facilities

[11] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, table 5, 14.
[12] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, table 5, 14.
[13] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, 4.

with perfect efficiency”[14]— is not illustrative for this analysis and will, therefore, be ignored. Because this analysis seeks to understand how to maximize forward combat presence in times of heightened international tensions, operating hours and average payloads are assumed to be maximized in response to the escalating crisis. Consequently, both operating hours and average payload are ignored.

After relieving these other variables, it becomes clear that MOG must be increased while ground times are decreased in order to optimize airfield throughput capacity. But, what is MOG? The associated note to the throughput equation—“use the lower of working, parking, or fuel MOG”—suggests the answer to this question.[15] Parking MOG refers to the maximum number of aircraft which can be accommodated on the airfield, the “spaces” a force has available to it in order to conduct upload and download operations. Working MOG, on the other hand, explains the capability an airfield has to upload, download, fuel, service, and prepare aircraft for departure. Fuel MOG, as its name implies, is the number of aircraft that can be fueled at any given time on an airfield. Because these operations are already incorporated into the definition of working MOG, delineating a unique fuel MOG is unnecessary.

As the definition of working MOG suggests, all of the vehicles and equipment, as well as the personnel required to operate these assets are critical to working MOG.[16] Ideally, working MOG equals parking MOG – the number of parking spaces available equal the requisite MHE and personnel able to work those spaces – but this is rarely the case.[17] Typically, MHE, trucks, buses, road networks, fuel tankers, sufficient number of trained load team personnel limit working MOG thereby

[14] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, 27.
[15] Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, 4.
[16] Air Force Instruction, *Deployment Planning and Execution*, 20 September 2012 incorporating through Change 2, 15 July 2014, 227.
[17] Air Force Instruction, *Deployment Planning and Execution*, 227.

limiting the throughput of an airfield.[18] The implication of working MOG's impact on airfield throughput is that logisticians cannot simply find a big block of concrete in an objective area and expect aerial port operations to magically take place. Deploying forces must add the enabling MHE and aerial port forces to their lift requirements in order to effectively transport a fighting force. Said differently, there is a significant personnel and equipment bill that is associated with moving and offloading a force, and that requirement brings with it its own weight and sustainment cost.

How We Currently Expand MOG

So how does the military currently increase working MOG at locations that have limitations? The answer is Contingency Response Forces. The DOD has several total-force contingency-response units, the majority of which fall under AMC's Contingency Response Wing (CRW). The wing is composed of two Contingency Response Groups (CRG), which can deploy in as little as 12-36 hours and can provide a working MOG of two aircraft for a 24-hour period.[19] Additionally, United States Air Forces Europe, Pacific Air Forces, and the Air Force Reserve each have a CRG. The CRG's main MOG-providing force is the Contingency Response Element (CRE), the rest of the group is composed of airfield security, communications, and a command staff.[20] Also resident in the CRW are Contingency Response Teams (CRT). CRTs offer a smaller force to airfields, providing a working MOG of one aircraft for twelve hours per day.

Putting It All Together

[18] Air Force Instruction, *Deployment Planning and Execution*, 227.
[19] 11-202v4 page 7.
[20] Much like the CREs, the Air National Guard and Air Force Reserve have several Airlift Control Flights capable of providing a working MOG of two aircraft for twenty-four hours per day. However, these forces provide only command and control and do not provide aerial port or maintenance capabilities. They can be augmented by traditional (non-contingency response trained) aerial port and maintenance troop if need be.

After inputting this data to the throughput equation, the stark realities of airfield output emerge. The C-17 and C-130 are the only large airlift aircraft with the capability to land at austere fields – often the most forward port of debarkation. As mentioned, the average expedited download time for these aircraft is one hour (forty-five minutes for the C-130 and one hour and fifteen minutes for the C-17). Consequently, a CRT provides a maximum throughput capacity of around 12 aircraft per day, equaling somewhere between 224 and 663 tons of cargo per day.[21] A CRE, on the other hand, can double this capacity granting an airfield the ability to work forty-eight aircraft per day totaling somewhere between 897 and 2,652 tons of cargo.[22] The smallest airlift analyzed, Task Force Hawk, required nearly 22,000 tons of cargo and nearly 500 C-17-equivalent loads to complete deployment. Based on a forgiving application of the throughput equation, the modest Task Force Hawk movement is expected to take over eight days. Readers should remember that this operation took thirty-eight days to complete in practice.

In addition, the throughput expectations outlined above are predicated on contingency-response forces arriving at an airfield prior to the movement of the fighting force, adding up to four additional C-17 sorties to the total lift requirement. Furthermore, contingency response forces require their own sustainment after the initial five days of an operation. Consequently, additional lift is continually added to the overall lift requirements depending on the duration of the operation. In

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[21] This math is based on using the throughput equation with maximum ACL, not planning factors. Air Force Pamphlet 10-1403: *Air Mobility Planning Factors* Table 8 page 16 estimates a MOG of 2 equalling a throughput of 282 sTons. The higher numbers are expected using ACL. Queing efficiency is included in both this text and the pamphlet's figures.

[22] This math is based on using the throughput equation with maximum ACL, not planning factors. Air Force Pamphlet 10-1403: *Air Mobility Planning Factors* Table 8 page 16 estimates a MOG of 2 equalling a throughput of 565 sTons. The higher numbers are expected using ACL. Queing efficiency is included in both this text and the pamphlet's figures.

essence, current MOG-enabling concepts of operation provide additional constraints on an already constricted port of debarkation.

Summary

To summarize, modern MHE represents an increase in scale—not a revolution—in logistics technology. As this chapter and the historical case studies suggest, the upload and download times of current aircraft, while comparatively short to their forbearers, are heavily reliant on this evolutionary MHE. Third, ground time and MOG—specifically working MOG—drives the throughput equation. Forward ports of debarkation are constrained by these two factors, choking throughput and slowing deployment of forces. Fourth, increasing working MOG imposes additional costs on the very logistics system it is trying to speed, by introducing additional cargo and personnel requirements to an already constrained node.

Given the current constraints on aerial logistics, how can the United States speed the deployment of forces to provide coercive presence? The next chapter details one attempt to find opportunities for investment in logistics technologies to speed this strategic capability.

CHAPTER 5

MODELING LOGISTICS

While the Yom Kippur War, Operation DESERT SHIELD/STORM, and Task Force Hawk cases provide historical validation of the theoretical concepts of deployable presence, these events also highlighted routine issues surrounding aerial logistics. The last chapter examined the current state of logistics technology and MOG-expanding forces, employing AMC's throughput equation to offer estimates of typical port-of-debarkation capacity. To fully understand where best to target investment, cost-burdened models are required to analyze different technologies and their impact on overall throughput. The professionals at the Defense Advanced Research Projects Agency's (DARPA) agree.

DARPA is perhaps best known for developing kinetic technologies like the M-16, Joint Strike Fighter, or lasers. However, the agency recognizes that the ability to create or prevent "strategic surprise" through a technological revolution in the speed and time of force deployment also warrants its analytic talents. So, DARPA began to imagine what technologies could enable the deployment of a brigade-sized force from taking months to mere days. To pursue transformational change of this magnitude requires the acceptance of significant monetary risk. Therefore, the agency commissioned the Johns Hopkins University's Applied Physics Laboratory (APL) and First Principles Advisory Group (FP) to create a robust logistics model and then infuse that model with future technologies to determine how they impacted the speed of force deployment. They modeled the utility of fast sealift and heavy vertical airlift, among other process improvements. The goal was to create a business-case analysis of potential technologies where military research and development could generate additional speed, thereby creating strategic advantage.

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Despite how advanced theoretical platforms like fast sealift or heavy vertical lift may speed transit time, they do little to resolve the most critical factor to deployment: upload and download constraints at the most forward node. The rest of this chapter explains the team, the model and its findings, as well as the implications for deployment of forward presence in the future.

The Team

JHU/APL is a university-affiliated research center (UARC) that provides analytic support and technology advancements to a number of government sponsors. In a nutshell, APL is made up of very smart people doing complex things to solve the defense department's most pressing challenges. Central to APL's role as a trusted agent is its complete neutrality. As a UARC, APL cannot respond to requests for proposal (RFP), and it does not produce platforms, systems, or equipment for resale. First Principles Advisory Group is a California-based management consultancy that co-developed several prior DARPA- and Office of Naval Research (ONR)-sponsored cost models of U.S. military air, maritime, and ground operations, with members of the current APL-led team. Team members have performed three similar prior DARPA- and ONR-sponsored projects that modeled the cost structure of U.S. military air, maritime, and land operations. Together, the team specializes in estimating the fully burdened cost structures of military forces by developing simple first-principle models of military operations and their supply chains with publicly available or sponsor-provided force-mix, basing-posture, operating-concept, platform-and payload-performance, and costs data.[1] The models they create are coarse enough to implement in Excel-spreadsheet form but granular enough to offer strategic

[1] W. Nolan Sherrill and Dr. H Todd Kauderer, "Joint Force Cost and Activity Modeling White Paper for Department of National Defence (Canada) (MOD-DRDC CORA), White Paper presented to Dr. Benjamin Taylor, A/Section Head Joint Systems Analysis, (Laurel, Maryland), 1.

insights.[2] The aim of each model is to help sponsors manage their technology investment portfolios by capturing the potential operational impact of emerging technologies and quantifying the cost-benefits of associated research-and-development activities.[3] Because their efforts seek to determine costs associated with the entire set of joint-service platforms, payloads, postures, and approaches, the models can be used to study a single campaign or to compare the cost impacts of technology across multiple campaigns simultaneously. This type of approach has proven to be especially useful in assessing non-program-of-record spending priorities and the consideration of alternative topologies.

The Model

With regard to the DARPA project, the APL/FP team was given a specific charge: demonstrate the cost and time impact of future technologies and alternative operating concepts that may be used to reduce the overall time to close for a deployment of a baseline mechanized infantry brigade.[4] Many potential scenarios and force sizes for this deployment could have been used, but DARPA and APL team chose a single set of factors to employ—a limited-duration, uncontested campaign, which involved a multi-service logistics response to deploy a Stryker Brigade Combat Team (SBCT) from the West Coast to respond to a major governmental collapse and ensuing anarchy on the Korean Peninsula.[5] Normalizing the model in this fashion allowed the node characteristics, technologies, and deployment concepts to be varied without drastically changing other variables: geography, distance, mass deployed, and threat environment.

The team built its model using both data-driven inference and qualitative research. When modeling logistics, a unified figure of merit

[2] Sherrill, "Joint Force Cost and Activity Modeling White Paper," 1.
[3] Sherrill, "Joint Force Cost and Activity Modeling White Paper," 1.
[4] Sherrill, *Strategic Mobility Architectures Summary*, slide 3.
[5] Sherrill, *Strategic Mobility Architectures Summary*, slide 14.

is required. The logistics industry standard appropriate for this type of supply-chain analysis is cost per ton-mile. This metric is the output used to normalize input and measure variables against each other in sensitivity analyses. However, to flesh out these variables, one must estimate fully burdened life-cycle costs of platforms, personnel, bases, and transport using DoD and industry best practices and processes.[6] To do this, APL's affordability-analysis group consulted over 100 entities, varying from open data sources—such as RAND and Bureau of Labor Statistics—to military databases—such as Army OSMIS and the Operation Logistics (OPLOG) Planner.[7] They then collected over 10,000 platform, fuel, personnel, base-structure, and Stryker Brigade Combat Team (SBCT) data points to aggregate costs for the modeling scenarios.[8]

APL/FP recognized that the numbers alone do not tell the entire story. Subject matter experts—logistics professionals and military leaders—were interviewed to give context to the model based upon recent SBCT deployments to Afghanistan. When completed, the study had a robust measure of the weight and fully burdened life cycle cost of the SBCT and the fully burdened costs of the nodes and modes of transport in order to develop the cost per ton-mile for deployment of the team. Given only current logistics technology, planning factors, and MOG-increasing operations, the APL/FP model calculated that it would take approximately 42.5 days to fully deploy an SBCT from the west coast to North Korea.[9]

That, however, only details the case for current technologies and methods of employment. The team used regression-based analysis to determine the potential fully burdened costs of two new technologies:

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[6] Sherrill, *Strategic Mobility Architectures Summary,* slide 7.
[7] Sherrill, *Strategic Mobility Architectures Summary,* slide 7.
[8] Sherrill, *Strategic Mobility Architectures Summary,* slide 7.
[9] W. Nolan Sherrill, *Strategic Mobility Architectures Summary,* (Johns Hopkins University Applied Physics Lab and First Principles Advisory Group, Laurel, Maryland) for Defense Advanced Research Projects Agency, 10 March 2015, slide 17.

Fast Sealift and HVTOL. Fast Sealift, for this model, is defined as an intertheater vessel that can carry 7000 tons for 8000 nautical miles at a speed of 35 knots.[10] For comparison, most sealift vessels currently steam at around 22 knots under similar weights and ranges. An HVTOL aircraft—again, for the purposes of the model—is an aircraft that can take off and land vertically, but can carry a payload of 36 tons a distance of 500 nautical miles at 220 knots.[11] This is very similar to the payload of the fixed-wing C-130J or A400M, though the vertical takeoff and landing capacity significantly decreases a HVTOLs range and speed. The fully burdened costs of these new technologies were modeled in the same way as other seagoing vessels and aircraft with one very important exception: the APL team also included in its models the research-and-development costs of these technologies.

Based on this varied and dynamic data, the APL team set about breaking that "base case"—an SBCT deployment from the west coast to North Korea— into 15 different situations where: 1) current technology or new technologies were employed, 2) all sealift, all airlift, or a mix of modes were employed, 3) prepositioned forces were used with current technologies of different modes, 4) prepositioning and new technologies were employed, and finally 5) the level of throughput at nodes was either optimal or fully constrained.[12] In all cases, cargo is moved from either CONUS or a regional prepositioning location to a staging location—referred to as Intermediate Staging Base (ISB)—and then on to a Forward Staging Base (FSB).

The fifteen different iterations of the model resulted in five important conclusions. First, "nodes and the Maximum on Ground (MOG) constraints at those nodes drive the overall timeline."[13] Second,

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[10] Sherrill, *Strategic Mobility Architectures Summary* slide 12
[11] Sherrill, *Strategic Mobility Architectures Summary* slide 12.
[12] Sherrill, *Strategic Mobility Architectures Summary,* slide 17-19, 24-27.
[13] Sherrill, *Strategic Mobility Architectures Summary* ,slide 36.

the activity at those nodes—upload and download, specifically—impact time.[14] Third, HVTOL will relieve MOG constraints at nodes.[15] (This is only partially true and is discussed later.) Fourth, the introduction of HVTOL technology and a new generation of upload/download technology could decrease throughput time at nodes by as much as 84%.[16] Fifth, "prepositioning has a dramatic impact on deployment time and does not require additional investments in technology but requires vehicle and equipment-set purchases."[17] Ultimately, "the combination of PREPO with the introduction of technology [— HVTOL and advanced upload/download technology—] saves considerable time in nearly all deployment concepts explored.[18]

Therefore, HVTOL technology relieves only parking MOG while the development of Fast Sealift merely speeds overall transit time. Though APL estimates that the introduction of HVTOL would halve the time required to deploy the SBCT (down to 30 days), its assumption is based upon the idea that HVTOL will impact working MOG as well as parking MOG.[19] Acquisition of fixed-wing aircraft to this point does not suggest that HVTOL will include a new technology that would alleviate working MOG. Consequently, working MOG will continue to operate as a constraint. While we can expect a greater number of Contingency Response Forces to have the opportunity to reach the most forward node if HVTOL opened up additional parking MOG "spaces," every increase in working MOG capability comes with it an increase in lift and sustainment requirements to the overall SBCT deployment. Therefore, while some level of reduction in overall time of deployment could be anticipated, it is unwise to assume as dramatic a reduction as the

[14] Sherrill, *Strategic Mobility Architectures Summary* ,slide 36.
[15] Sherrill, *Strategic Mobility Architectures Summary* ,slide 36.
[16] Sherrill, *Strategic Mobility Architectures Summary,* slide 34.
[17] Sherrill, *Strategic Mobility Architectures Summary,* slide 36.
[18] Sherrill, *Strategic Mobility Architectures Summary,* slide 36.
[19] Sherrill, *Strategic Mobility Architectures Summary*, slide 19.

APL/FP team suggests. Fast Sealift suffers the same issues, as the port requirements and the subsequent download capability do not increase with an overall increase in transit time of the vessels.[20] In a manner, the team accurately found the constraining factors: increasing working MOG and decreasing upload and download times is required in order to drastically affect the timeline for SBCT deployment.

Conclusion

The foregoing analysis does not suggest that investment in HVTOL or Fast Sealift technologies is unwarranted. Rate of transit and parking MOG constraints remain serious limitations on kinetic-force deployment; however, investment to impact these variables without commensurate investment in relaxing working-MOG constraints fails to ease the most immediate limits on throughput. DARPA now recognizes the need for investment in technologies that revolutionize upload and download of kinetic forces at the forward-most port of debarkation. In the summer of 2016, DARPA plans to solicit proposals for technical demonstrations of automatic upload/download technologies.[21] Should one of these demonstrations lead to the development of a fielded solution to working MOG, advances in HLVTOL and Fast Sealift may improve the United States' capacity to deploy forward presence. The next and final chapter brings together the two fundamental theses of this paper: forward-deployed military presence is coercive; increasing speed of deployment is important to achieve the United States' national security objectives; and investment in technologies that relax working MOG constraints is the first step to ensure rapid deployment of that military presence.

[20] Sherrill, *Strategic Mobility Architectures Summary*, slide 24.
[21] Major Christopher Orlowski, PhD (DARPA Program Manager), interviewed by the author, 26 February 2016.

CHAPTER 6

THE FUTURE OF DOWNLOADING DETERRENCE

The intellectual journey this paper charted started with a review of the theoretical underpinnings of coercion and presence. The increasing capabilities of conventional forces theoretically increase the coercive capacity of military presence.

The subsequent analysis of three historical cases of mobile deployment and sustainment suggests that the Untied States' capacity to rapidly support or insert military presence provides coercive effect. Israel's conventional and nuclear deterrents failed to forestall an Egyptian and Syrian invasion of Israel; however, the Israeli Defense Force quickly turned the tides of the conflict. Supported by critical supplies from the United States, Israel launched an offensive that culminated in reestablishing the territorial lines that existed prior to the conflict. The materiel and morale sustainment provided by the United States proved critical to Israel's coercive victory – a deterrent effect that appears to endure.

In 1991, a U.S.-led coalition rapidly established presence in Saudi Arabia to prevent Iraq from driving further south into the Arabian peninsula in the event Saddam Hussein had wished to do so. The subsequent deployment of combat presence, culminating in devastating airstrikes on the Iraqi command-and-control facilities and fielded forces effectively coerced Saddam Hussein. The Coalition's changing objectives drove an eventual land invasion; however, the cumulative coercive strategy, which included military presence, was successful. The more than five months Saddam offered the coalition to deploy allowed the United States to overcome the challenges of the deployment, and may suggest he never intended to take the Saudi oil fields. Consequently, it is

unclear whether a more rapid deployment would have coerced him any earlier. Unfortunately, the world witnessed the coercive military power that the United States could muster if given time, and potential adversaries may not allow similar timelines in the future contests.

Much like the two other cases, the deployment of Task Force Hawk played a critical role in the coercive strategy to halt ethnic cleansing in Kosovo. While NATO aircraft screamed overhead, the looming threat of a ground invasion drove Serbian fielded forces to abandon much of their ethnic cleansing operations in order to prepare defensive positions along the Albanian border. While a more rapid deployment on its own may not have coerced the Serbian leader any more quickly, who knows how many ethnic Albanians lives may have been spared had Task Force Hawk threatened invasion sooner. The sum of this paper's historical review confirms that deploying and sustaining conventional presence is a critical factor in comprehensive coercive strategies. It stands to reason that deploying those forces more rapidly ratchets up the cumulative pressure on adversaries.

Unfortunately, scaling our current logistics capabilities will not work. The underlying principles of current technologies have likely reached the maximum amount of speed and capability we can expect. As the review of current technologies, concepts of operations, and expeditionary logistics forces show, America's present capacity to deploy employs evolutionary technologies and manpower – all of which add to deployment constraints with small impact to throughput. The DARPA-commissioned study supports this analysis. The manpower-intensive downloads witnessed in the Yom Kippur War can't always be expected, and the deployment of contingency-response forces – as seen in Operation DESERT STORM and the Kosovo War – have reached their maximum throughput capacity. Therefore, to speed the deployment of

coercive presence requires imaginative solutions to the problems of increasing working MOG and decreasing upload and download time.

If technologies existed, however, that could keep palletized cargo palletized, while still eliminating the need for MHE, working MOG would no longer limit the throughput equation. Additionally, if personnel already imbedded in the SBCT could act as the download team, no additional contingency response forces—and, subsequently, weight, cost, and time—would be required. Stated differently, by eliminating the difficulty in increasing working MOG while decreasing download equipment and download time, a revolution in the logistics enterprise can take place.

While a complex concept, an example makes the concept more clear. Imagine this scenario. A few soldiers belonging to an SBCT need to build a pallet full of Meals, Ready to Eat (MREs) for a rapid response to North Korea. Imagine they packed that pallet up to 9,500 lbs. Then, when fully outfitted in their combat gear, the soldiers walked the pallet onto an aircraft without any heavy equipment. The loadmaster aboard then secured the pallet in place for transport. Now, imagine that this aircraft flew and then landed at an austere base in North Korea. The other cargo is rapidly downloading—a Stryker drives off, two HUMVEEs follow, and fifty troops stand up and grab their packs and weapons. Just before the last two soldiers leave, the aircraft's loadmaster releases the MRE pallet from its restraints. Without any heavy equipment, those same two troops guide the pallet down the ramp, following their squadmates, pushing the pallet with ease to the edge of the airfield. As the pallet settles next to the squad's rally point, the aircraft closes its cargo ramp and door and prepares for takeoff. The entire offload took less than 10 minutes. While that offload time is incredible, what is equally incredible is that twelve HVTOL aircraft were downloading up and down the runway at the same time. As they lift off, the two soldiers

hear the next twelve aircraft making their approach, bringing the rest of the battalion, setting the stage for the rest of the brigade.

In our imaginary scenario a few amazing – revolutionary – things have happened. First, the pallet either rolls or floats on command. These new pallets relieve the forward node of the need for heavy equipment, trained heavy-equipment operators, and all of the support materiel necessary for a functioning aerial port. Suddenly, working MOG has lifted. Parking MOG now dominates our throughput equation. Consistent with the APL model, HVTOL aircraft and their unique capabilities can now speed logistics to and through a forward node where parking MOG may have restricted logistics flow.

For now, the future of downloading deterrence remains uncharted. The DARPA request for proposals forecast for 2016 may hold the answer to the United States' future capacity to rapidly project military coercive presence around the globe. Investment in pallet technology – as outlined above – is one possible solution. Others may include 3-D printing stations at the forward-most port of debarkation or shipboard forces in smart containers that continually manage the maintenance of the materiel stored inside. Whatever target research-and-development dollars are assigned, the focus must be on those technologies or concepts of operation that will unburden throughput from the constraints that have limited it for the past century.

The United States should focus on revolutionizing logistics. Otherwise, it must rely on the good fortune of having permanently-stationed forces near locations of future conflict or be beholden to the logistics capacity resident in foreign partners. In either case, relying on good fortune or good will is the basis for unsound national security strategy.

Despite the failures of BIG LIFT, Secretary McNamara correctly assessed the future. Deploying forces rapidly from the United States

should be the cornerstone of American power projection. The history of the United States' application of forward military presence has been and continues to move toward such a strategy. The current challenge is to find technical solutions to current constraints in downloading deterrence.

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